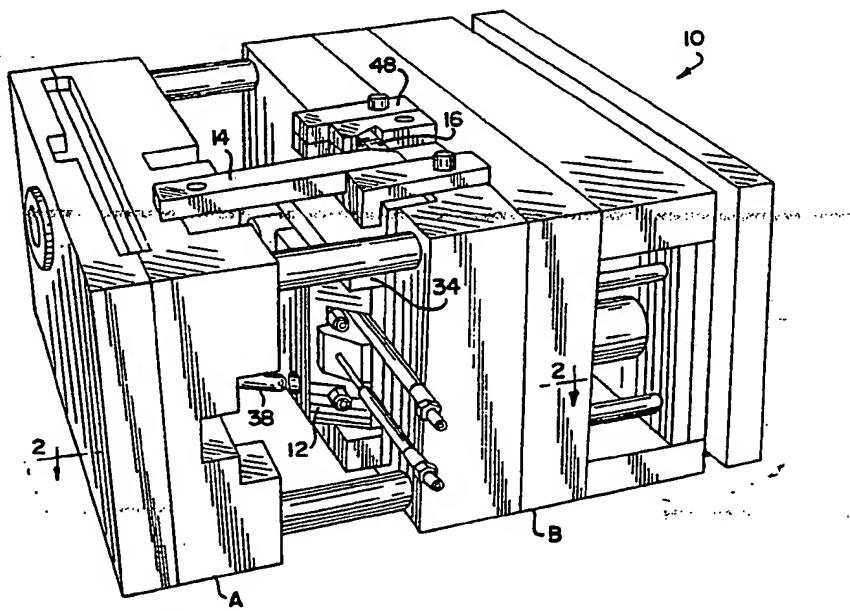




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :  B29C 45/00, 45/03	A1	(11) International Publication Number: WO 93/13927  (43) International Publication Date: 22 July 1993 (22.07.93)
(21) International Application Number: PCT/US92/11036		(74) Agents: SANDER, Dorothy, L. et al.; S.C. Johnson & Son, Inc., Patent Section, 1525 Howe Street, Racine, WI 53403-5011 (US).
(22) International Filing Date: 22 December 1992 (22.12.92)		
(30) Priority data: 07/820,841 15 January 1992 (15.01.92) US		(81) Designated States: AU, BR, CA, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
(71) Applicant: S.C. JOHNSON & SON, INC. [US/US]; 1525 Howe Street, Racine, WI 53403-5011 (US).		Published <i>With international search report.</i>
(72) Inventors: MUSIEL, D., James ; 435 William Street, Racine, WI 53402 (US). HADSELL, William, C. ; 2643 W. Brookwood Court, Phoenix, AZ 85044 (US). OESTREICH, Craig, R. ; 10770 E. Mescal Street, Scottsdale, AZ 85259 (US).		

(54) Title: IN-MOLD FORMATION AND ASSEMBLY OF ACTUATOR-OVERCAP AND INSERT NOZZLE



## (57) Abstract

A molding mechanism (10) and method of using that mechanism for simultaneously forming, by injection molding, two molded parts intended to be interference fit together and then, while the two molded parts are still within the molding mechanism (10), repositioning them and fitting them together. The sequenced interplay of the moving parts of the molding mechanism (10) which accomplishes this process may be controlled by either a "two-part" (14 and 16) or a "single-part" (52) camming mechanism. The two molded parts may be an actuator-overcap (18) and a spray nozzle insert (20).

BEST AVAILABLE COPY

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	MR	Mauritania
AU	Australia	CA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NL	Netherlands
BE	Belgium	GN	Guinea	NO	Norway
BF	Burkina Faso	GR	Greece	NZ	New Zealand
BG	Bulgaria	HU	Hungary	PL	Poland
BJ	Benin	IE	Ireland	PT	Portugal
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SK	Slovak Republic
CI	Côte d'Ivoire	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	MC	Monaco	TG	Togo
DE	Germany	MG	Madagascar	UA	Ukraine
DK	Denmark	MIL	Mali	US	United States of America
ES	Spain	MN	Mongolia	VN	Viet Nam
FI	Finland				

In-Mold Formation and Assembly of Actuator-Overcap  
and Insert Nozzle

5

Technical Field

This invention relates to the field of injection molding and assembling of plastic parts, and particularly to a molding mechanism for simultaneous formation of an actuator-overcap and a spray nozzle insert followed by in-mold assembly of the two parts.

10

Background Art

The molding of overcaps for pressurized containers with integrally formed actuators designed to interact with a stem protruding from the top of the container to release the contents is well known. Such actuator-overcaps have an integrally formed fluid releasing channel that, at the inlet end, connects with the container stem. At the outlet end of the channel is usually inserted a spray forming nozzle which can have a swirl, flow restricting or nebulizing chamber as well as a discharge orifice. The chamber and orifice sizes and configurations are adjusted to provide the desired spray pattern and droplet size.

The usual method of formation of such an actuator-overcap nozzle assembly is to individually mold the actuator-overcap and the nozzle insert from thermoplastic material. Then, in a secondary assembly operation, the nozzle is pressed with interference fit into the outlet opening of the fluid releasing channel of the actuator-overcap.

30

This subsequent assembly step means that the two types of parts must be made, stored and handled, and then manually fitted together or fed to an assembly machine. The separate formation of the two parts also means that, unless all operations are conducted under controlled conditions,

35

environmental conditions such as heat and humidity may differ between the formation of the actuator-overcap and the nozzle insert. Since the two are to be interference-fit together, tolerances are small, and minute variations in the

- 2 -

behavior of the thermoplastic in the molding process may result in a larger proportion of non-secure fits.

Both problems - of labor and of control of conditions - would be solved by single step formation of the entire assembly. However, molding the actuator-overcap and nozzle insert as a single unit is not possible, due to molding technique restrictions. Simultaneous in-mold formation and assembly of the two parts would also solve the problems discussed above.

10 The integral molding of caps for dispensers having a plug portion attached to the cap portion is well known. U.S. Pat. No. 4,253,609 to Laauwe, "Dispensing Spray Nozzle", is of this type. The in-mold assembly of such an article is also known. U.S. Pat. No. 4,340,352 to Hayberg, 15 "Hinge Exercising Mechanism," discloses a molding mechanism having a moveable finger which, after the cap-lid combination is molded, sweeps over the lid portion and snaps it into the cap portion.

A method of assembling and forming a delivery head and 20 a break-up insert attached to the head by an attachment strip is disclosed in U.S. Pat. No. 4,741,088 to Ramella, "Method of Making a Delivery Head For Containers of Substances To Be Nebulized Having A Break-Up Plastic Insert Integrally Formed With The Head". When the mold parts 25 separate, a mold fence first pushes against the attachment strip and swings it up against the head, forcing the insert into the outlet opening of the head, which is then stripped from the mold.

#### Summary Disclosure of the Invention

30 The present invention is a molding mechanism that will form and assemble an actuator-overcap with a nozzle insert in a single operation. A push rod, moveably mounted on a slide attached to one portion of the mold has a pin on its end that forms the discharge orifice of the nozzle insert. 35 Then, the mold is opened, the slide moves laterally and axially separating the nozzle insert from its forming position, then repositioning it, and inserting it into the discharge outlet of the actuator-overcap. A swirl chamber is formed between the interior end of the nozzle insert and

- 3 -

the protruding end of the fluid outlet of the actuator-overcap.

Brief Description of the Drawings

Figures 1-13 illustrate a first embodiment of the  
5 invention.

Figure 1 is a perspective view of the molding mechanism, showing the A and B components in the separated position.

Figure 2 is a partial side sectional view of the  
10 molding mechanism, taken along line 2-2 of Figure 1, showing the A and B mold components in the separated position and the insert engaging pin retracted, before the actuator-overcap has been molded.

Figure 2a is an elevational view of the end of the  
15 insert engaging pin.

Figure 3 is a partial sectional view of the same elements as Figure 2 but with the A and B mold components in the joined position and the actuator-overcap and the spray nozzle insert formed therebetween.

20 Figure 4 shows the same view and elements as Figure 3 but with the mold components in the opened position, the insert engaging pin extended, and the spray nozzle insert repositioned and inserted within the actuator-overcap.

Figure 5 is an enlarged detail side sectional view  
25 showing mold components A and B as shown in Figure 2 in their joined position with the actuator-overcap and spray nozzle insert formed therebetween, with the insert engaging pin in contact with the formed spray nozzle insert.

Figure 6 shows the same view and elements as Figure 5,  
30 but with the A and B mold components in the joined position with the insert engaging pin and spray nozzle insert all repositioned ready for assembly.

Figure 7 shows the same view and elements as Figure 5 but with the insert engaging pin in its extended position  
35 and the spray nozzle insert fitted within the actuator-overcap.

Figure 8 is a partially sectioned perspective view of the molded and assembled actuator-overcap and spray nozzle insert.

- 4 -

Figure 9 is a partial plan view of the cam mechanism of the molding mechanism in the fully opened position.

Figure 10 shows the same elements as Figure 9 but in relative positions as the mold closes.

5 Figure 11 shows the same elements as Figure 9 but with the mold in a fully closed position.

Figure 12 shows the same elements as Figure 9 but in relative positions as the mold opens.

10 Figure 13 shows the same elements as Figure 9 but with the mold in the fully opened position.

Figures 14-18B illustrate a second embodiment of the invention.

15 Figure 14A shows, in partial side sectional view, the functional elements of the second embodiment in positions that correspond with those of the molding mechanism of Figure 3.

Figure 14B, taken along line 14B-14B on Figure 14A, shows a partial top sectional view of the moving cam bar and the cam followers.

20 Figure 15A shows the same elements as depicted in Figure 14A (except for mold component A), but in positions corresponding to the retraction of the inserting pin.

Figure 15B, taken along a section line at right angles to Figure 14A, shows a partial side sectional view of the 25 moving cam bar and cam roller.

Figure 16A shows the same elements depicted in Figure 15A but in positions corresponding to the repositioning of the inserting pin.

Figure 16B, taken along line 16B-16B of Figure 16A, 30 shows the same elements depicted in Figure 14B but in positions corresponding to Figure 16A.

Figure 16C shows the same elements depicted in Figure 15B but in positions corresponding to Figure 16A.

Figure 17A shows the same elements depicted in 35 Figure 15A but in positions corresponding to Figure 4.

Figure 17B, taken along line 17B-17B of Figure 17A, shows the same elements depicted in Figure 14B but in positions corresponding with Figure 17A.

- 5 -

Figure 18A shows the same elements as Figure 15A, but in positions corresponding with the assembly process after insertion of the nozzle insert and retraction of the inserting pin.

- 5       Figure 18B taken along line 18B-18B of Figure 18A shows the same elements as Figure 14B, but in positions corresponding with 18A.

Best Modes for Carrying Out The Invention

The essence of this invention is the sequenced 10 interplay of the particular components of the molding mechanism. However, such sequenced interplay can be obtained by different mechanisms for the timed and spaced transfer of energy, and by different means for energizing such mechanisms. The essential components of the molding 15 mechanism and the necessary sequence of relative motions of those components to accomplish the in-mold formation and assembly of an actuator-overcap and spray nozzle insert are discussed here with two possible mechanisms for the control of the sequenced interplay of the components. These two 20 embodiments have been tested and both have proved fully functional. However, other mechanisms and other means of energizing the mechanisms could be utilized to control the sequenced interplay of the components of the molding mechanism.

25       Figures 1-13 all illustrate a first embodiment of the invention, in which the mechanisms for controlling the relative motions of the components of the molding mechanism are interrelated but distinct. Figures 14A-18B illustrate a second embodiment of the invention, which is described in 30 less detail than in the first embodiment, since the essential components of the molding mechanism remain the same but the mechanism for controlling the relative motions of those components is different. In this second embodiment, a single mechanism serves to sequentially 35 activate the various components.

Figure 1 shows a perspective view of molding mechanism 10 which has two major components - mold component A, as the stationary part of a mold assembly is customarily termed, and mold component B, as the moving part

- 6 -

of a mold assembly is customarily termed. These two components are slidably joined by bars, as is well known to those skilled in the art, so such structure is not discussed here. Nor are the conventional and required cooling mechanisms for such molding mechanisms discussed.

5 Detachably connected to mold component B is slide 12, which is a component of the means for repositioning and inserting the spray nozzle insert into the actuator-overcap. Located upon mold component A is stationary cam bar 14, which is

10 designed to operatively interconnect with moveable cam 16 located upon mold component B.

Figures 2-4 show the molding and assembly of the actuator-overcap and spray nozzle insert in the context of the total molding mechanism. Figures 5-7 show, in

15 simplified detail for clarity, the in-mold assembly of the actuator-overcap and the spray nozzle insert. Figures 9-13 show the mechanism by which the motions of the parts of the molding mechanism are accomplished.

Figure 2 shows mold component A and mold component B separated, before molding has taken place. Forming part of and protruding from mold component B is actuator-overcap forming core 22, which is designed to fit against and form a mold with actuator-overcap forming cavity 24 formed within mold component A. Actuator-overcap forming cavity 24 is

25 actually, as more easily seen in Figure 3, only a portion of the required mold structure, the "front" portion of the actuator-overcap mold structure being formed by the configuration of slide 12 and insert engaging pin 26.

Insert forming cavity 28 is formed within actuator-overcap

30 forming core 22.

Detachably connected to mold component B is an assembly made up of riser plate 34, which is extensibly connected to mold component B by springs 36, and slide 12', which is itself moveably connected to riser plate 34. Moveably

35 located within slide 12 is insert engaging pin 26, which, together with insert forming cavity 28, creates the mold for spray nozzle insert 20.

In Figure 2, insert engaging pin 26 is in its "retracted" position within slide 12.

- 7 -

As mold components A and B are joined to create the mold, the assembly formed by riser plate 34, slide 12, and insert engaging pin 26 is moved into molding position against mold component A along diagonally oriented diagonal 5 cam pin 38 by pressure exerted on mold component B by the mold press into which the molding mechanism of the present invention will have been placed for operation.

As Figure 3 shows, when mold component A and mold component B are joined, mold component A presses against 10 slide 12 and thus applies pressure to riser plate 34 and compresses springs 36.

In this Figure (and shown in expanded detail in Figure 5), insert engaging pin 26 has been moved forward within slide 12 to its molding position so that insert 15 engaging pin 26 is now located adjacent insert forming cavity 28. In this position, insert engaging pin 26, and insert forming cavity 28 together form the structure of the mold for spray nozzle insert 20.

Insert engaging pin 26 is so designed that, when spray 20 nozzle insert 20 is molded from injected thermoplastic material, spray nozzle insert 20 becomes detachably engaged by pin indent 29 located around the tip of insert engaging pin 26.

Pin indent 29 is best visible in Figure 2A (which shows 25 a front elevational view of the tip of insert engaging pin 26) and Figures 5-7.

In Figure 3 (and Figure 5), the mold cavities formed between mold components A and B and insert engaging pin 26 are shown after the injection of thermoplastic material. 30 Thus, actuator-overcap 18 and spray nozzle insert 20 have been formed, but not yet assembled.

After the injection molding has been completed, the molding and assembling mechanism of the present invention separates the formed spray nozzle insert from its molding 35 location, repositions it, and then inserts it into the formed actuator-overcap. This is shown in Figures 6, 4, and 7.

As the stage depicted in Figure 3 approaches that shown by Figure 4, mold component B separates from mold

- 8 -

component A, and springs 36 extend, pushing riser plate 34 away from the surface of mold component B. Riser stop 37 limits the extent of this separation motion.

Simultaneously, slide 12 (carrying with it insert engaging pin 26), which is attached to riser plate 34, moves along diagonally oriented diagonal cam pin 38, moving laterally relative to riser plate 34 and axially away from formed actuator-overcap 18. This lateral and axial motion is necessary, for the tip of insert engaging pin 26 must pull formed spray nozzle insert 20 out of its molding position within insert forming cavity 28 far enough so that, as insert engaging pin 26 repositions spray nozzle insert 20 adjacent actuator-overcap outlet structure 30 of actuator-overcap 18, spray nozzle insert 20 clears the lip of actuator-overcap outlet structure 30.

After the assembly formed by riser plate 34, slide 12 and insert engaging pin 26 has moved to its extended position (out of contact with mold component B), spray nozzle insert 20, as said before, is in position opposite actuator-overcap outlet structure 30.

Figure 6 shows a partial sectional view of this intermediate position, with insert engaging pin 26 holding spray nozzle insert 20 positioned for insertion into actuator-overcap outlet structure 30.

In the stage depicted in Figure 7, mold components A and B have separated and insert engaging pin 26 is forced forward, by pneumatic pressure, to its inserting position, thus interference-fitting spray nozzle insert 20 into actuator-overcap outlet structure 30.

Figure 8 shows (in a partially sectioned perspective) molded actuator-overcap 18, which has integrally formed therewith actuator button 32. Spray nozzle insert 20 has, by the molding and assembly method described, been interference-fit into one end of actuator-overcap outlet structure 30 of actuator-overcap 18. In use, actuator-overcap 18 will sit over a fluid valve stem which projects from a reservoir. In the preferred embodiment (not shown here), the reservoir will be a conventional pressurized aerosol dispensing can with a fluid valve stem projecting

- 9 -

from its top (although the actuator-overcap assembly could also be used with a pump-type dispenser). When the user depresses actuator button 32, the pressurized aerosol exits the valve stem, enters actuator-overcap fluid inlet 40, is 5 directed out actuator-overcap outlet structure 30, enters swirl chamber 42 within spray nozzle insert 20, and finally exits spray discharge orifice 44.

Figures 9-13 show details of the mechanism which controls the operation of the in-mold formation and assembly 10 of the actuator-overcap and spray nozzle insert as the mold is closed and then is opened.

Figure 9 shows, when mold components A and B are separated and before they are joined, the relative positions of the parts of the molding mechanism that control the 15 timing of the motions of the various components of the molding mechanism. Located on mold component A is stationary cam bar 14. Located on top of riser plate 34 (which is detachably connected to slide 12, which in turn is operatively connected to mold component B and is best 20 illustrated in Figures 2-4) is angled moveable cam 16, which is laterally moveable within cam slot 46. Located at one end of cam slot 46 is limit stop 48 which has limit notch 50 located therein.

When mold components A and B are separated, moveable 25 cam 16 is in position within cam slot 46 and completely outside of limit notch 50. In this position, riser plate 34 is held away from the inner surface of mold component B by springs 36 (visible in Figures 2-4).

As mold components A and B move together, as shown in 30 Figure 10, the angled edge of stationary cam bar 14 comes into contact with and presses against the angled end of moveable cam 16. Moveable cam 16 is, by this pressure, moved within cam slot 46 in the direction of limit notch 50. Simultaneously, the pressure of stationary cam bar 14 35 against moveable cam 16 presses riser plate 34 to which slide 12 is connected back against the inner surface of mold component B.

Figure 11 shows mold components A and B joined, in the molding position (also shown in Figure 3). Stationary cam

- 10 -

bar 14 has pushed past moveable cam 16, and has moved moveable cam 16 within cam slot 46 and positioned moveable cam 16 against the back of and fully into limit notch 50.

Riser plate 34 is now pressed back against mold 5 component B and springs 36 (not visible in this Figure) are compressed.

Figures 12 and 13 show that, as mold components A and B separate, after the injection molding, the relative motions of stationary cam bar 14 and moveable cam 16 repeat, in 10 reverse, the motions depicted in Figures 10 and 9.

In a second embodiment of the invention (depicted in Figures 14A-18B), all the essential elements of the molding assembly and the necessary sequencing of steps are the same as in the first embodiment. Only the mechanism by which the 15 relative actions of the riser plate, the slide, and the insert engaging pin are controlled is different. Figure 1, described above, shows, located on the top portion of mold component A, stationary cam bar 14, and on mold component B, moveable cam 16, as well as limit stop 48. These elements 20 are lacking in the second embodiment, for the cam mechanism is internal to the molding mechanism 10. Otherwise, the external appearance of molding mechanism 10 is the same for either embodiment.

Figure 14A shows in partial section those parts of 25 molding mechanism 10 that are connected to mold component B, in the same relative positions as they are depicted and described above by Figure 3. Slide 12, within which insert engaging pin 26 is moveably located, is slidably connected to riser plate 34.

30 In this embodiment, positioned within the interior side of riser plate 34 is moving cam bar 52, which is shown in partial top view in Figure 14B and in side view in Figure 15B. Moving cam bar 52 has formed in the top or inner surface thereof (facing riser plate 34) T-shaped cam 35 channel 54. T-shaped cam channel 54 is made up of cam channel top leg 56 and cam channel bottom leg 58.

Cam channel bottom leg 58 has two main sections: angled leg neck section 60, which, after an initial connection portion where it joins cam channel top leg 56, is

- 11 -

angled, preferably at a 30° angle, away from the perpendicular. Cam leg base section 62 is configured so as to be essentially perpendicular to cam channel top leg 56, preferably at an angle of 2° from the perpendicular, to 5 allow for increased pressure on insert engaging pin 26 and fine adjustment of the final insertion location for spray nozzle insert 20.

As described before, as mold components A and B are brought together, slide 12 is positioned forward relative to 10 riser plate 34 by the motion of slide 12 relative to diagonal cam pin 38.

As stated before, the difference between the first and the second embodiments lies in the operating mechanism that controls the relative assembly steps. It is the relative 15 motions of a first and a second cam follower and a cam roller within their respective moveable locations that control these actions.

The relative motions of cam roller 70 and cam roller pocket 68 control the motion of riser plate 34 relative to 20 mold component B (positioning insert engaging pin 26) and the relative motions of first cam follower 64 and second cam follower 66, both relative to T-shaped cam channel 54, and cam follower pocket 72 control the relative motions of slide 12.

Moving cam bar 52 has formed within its top surface T-shaped cam channel 54, as described before. Within T-shaped cam channel 54 moveably rest first cam follower 64, which is connected to slide 12, and second cam follower 66, which is connected to insert engaging pin 26. 25

As shown in Figure 15B, formed into the bottom surface of moving cam bar 52 (opposite the side containing T-shaped cam channel 54) is cam roller pocket 68. Rotatably attached to mold component B is cam roller 70 which, when mold components A and B are closed, rests within cam roller 30 pocket 68. 35

When mold component A and mold component B are separated, before all molding and assembly steps, first cam follower 64 is located within cam follower pocket 72 which, in this position, is coextensive with cam channel top leg 56

- 12 -

(in moving cam bar 52), and is located within riser plate 34, and second cam follower 66 which is located within cam channel top leg 56.

As mold component B moves toward mold component A, 5 moveable slide 12 moves forward, as shown in Figure 14A. In this position, injection molding is accomplished in the same manner as described before. After injection molding of the actuator-overcap and spray nozzle insert has been completed, 10 mold components A and B separate. Slide 12 moves backward relative to riser plate 34, pulling spray nozzle insert 20 out of its molded position within actuator-overcap forming core 22, all as described before with reference to 15 embodiment one (see Figures 15A and 15B).

After injection molding has formed actuator-overcap 18 20 and spray nozzle insert 20, the assembly operations begin. At this point, hydraulic pressure moves moving cam bar 52 relative to slide 12, and two types of motion begin to occur simultaneously - riser plate 34 and insert engaging pin 26 both move to perform a sequential operation which results in 25 the inserting of spray nozzle insert 20 into actuator overcap 18.

Moving cam bar 52 is moved relative to cam roller 70, which is connected to mold component B. As moving cam bar 52 moves over cam roller 70, cam roller pocket 68 is 25 moved away from its position over cam roller 70. Since cam roller 70 projects above the inner surface of mold component B (See Figure 16C), riser plate 34 is forced, by this action, away from the surface of mold component B. This positions insert engaging pin 26 (with spray nozzle 30 insert 20) in line with actuator-overcap outlet structure 30 (see Figures 16A and 16B). Second cam follower 66 is moved by the motion of moving cam bar 52 downward into cam channel bottom leg 58 of angled T-shaped cam channel 54. Since 35 second cam follower 66 is attached to insert engaging pin 26, this action forces insert engaging pin 26 relatively forward, and results in spray nozzle insert 20 being inserted into actuator-overcap outlet structure 30 (see Figures 17A and 17B). While this is happening, first cam follower 64 is retained in cam follower pocket 72, which

- 13 -

prevents slide 12 from moving during the insert assembly process. The hydraulic pressure is then reversed, and all components, moving cam bar 52, first cam follower 64, and second cam follower 66, return to the positions shown in  
5 Figures 18A and 18B.

The assembled actuator-overcap with the spray nozzle insert is now ejected from the molding assembly by conventional mold ejection technology.

Other modifications of the molding mechanism of the  
10 present invention will become apparent to those skilled in the art from an examination of the above patent Specification and drawings. Therefore, other variations of the present invention may be made which fall within the scope of the following claims even though such variations  
15 were not specifically discussed above.

#### Industrial Applicability

This invention could be used to produce any molded item that, due to design or uniqueness, must be made in multiple pieces and then put together in a secondary operation.

20 Through use of hydraulics, pneumatics, mechanical devices, and combination of these existing molding techniques, the assemblies can be made in a single cycle within an injection mold to make the part manufactured more cost efficient. Examples would be push/pull dispenser caps, aerosol spray  
25 buttons and overcaps, pump spray devices, makeup cases, two-piece plastic snap-together containers, etc. Molded parts can be held together by either an interference fit or by snap locking retainers designed into the plastic part.

What I claim:

1. A molding mechanism which will, first, simultaneously form, from injected thermoplastic material, a first molded part and a second molded part, the second molded part being intended to be joined to the first molded part, and, second, reposition and fit the second molded part into the first molded part, the molding mechanism being characterized by having:

an A mold component having formed therein a cavity designed to form the first molded part, and access means to allow injected thermoplastic material to reach that cavity,

a B mold component having protruding therefrom a core designed to form both molded parts, the core having formed therein a cavity designed to form the second molded part, and, moveably connected to the B mold component, means for repositioning and fitting the second molded part into the first molded part,

the A and B mold components, when fitted together, being configured to form the first molded part within the gap between the core designed to form both molded parts and the cavity designed to form the first molded part, and then to form the second molded part between the cavity designed to form the second molded part, and a second molded part-engaging pin, which is moveably attached to the means for repositioning and inserting the second molded part,

the A and B mold components being designed to be separated after the formation of the first molded part and the second molded part, during which separation the means for repositioning the second molded part causes the second molded part to be removed from its position with the cavity designed to form the first molded part, repositioned to a position adjacent to the desired location on the first molded part, and then fitted into that desired location in the first molded part, and

moveably located upon the B component, means for stripping the assembled first and second molded parts from the mold after separation of the A and B mold components and after the second molded part has been fitted into the first molded part.

- 15 -

2. A molding mechanism according to Claim 1 wherein the means for repositioning and inserting the second molded part is made up of, moveably connected to the B mold component, an independently moveable riser plate on which is mounted a 5 slide and, located upon the slide, a second molded part-engaging pin,

the slide, riser plate, and second molded part-engaging pin, all attached to the B mold component, being designed to operatively engage the A mold component so that, when the

10 A and B mold components are fitted together and thermoplastic material injected into the gap in the molding mechanism formed by this fit (thus forming the first and second molded parts), the second molded part-engaging pin fits into the cavity designed to form the second molded part

15 within the core designed to form both molded parts on the B mold component and forms an attachment to the second molded part, and, as the A and B mold components are separated, the combination of the slide, riser plate, and insert engaging pin moves laterally and axially away from

20 the core designed to form both molded parts, thus removing the second molded part out of the cavity designed to form the second molded part, the riser plate then moving relative to the slide so as to position the second molded part adjacent to the desired location on the first molded part,

25 the second molded part-engaging pin then moving forward, inserting the second molded part into the desired location in the first molded part, and then retracting, the assembled first and second molded parts being stripped from the mold after separation of the A and B mold components and after 30 the second molded part has been fitted into the first molded part.

3. A mechanism according to Claim 2 wherein the motion of the riser plate relative to the mold component is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate is controlled by a two-part cam mechanism, which has a straight stationary cam bar portion located on the A mold component designed to interact with a moveable cam located on the B mold component, the motion of the second molded part-engaging pin relative to the slide

- 16 -

being independently controlled by pneumatic pressure applied to the second molded part-engaging pin.

4. A mechanism according to Claim 2 wherein the motion of the riser plate relative to mold component B is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate and of the second mold part-engaging pin relative to the slide are both controlled by hydraulic pressure which activates a single cam mechanism, said cam mechanism being made up of a moving cam bar having formed into one surface thereof an essentially T-shaped channel, and having first and second cam followers located so as to be moveable within the essentially T-shaped channel, the first cam follower being connected to the slide and the second cam follower being connected to the second mold part-engaging pin, the moving cam bar further having, formed into the surface opposite the one containing the essentially T-shaped cam channel, a cam roller pocket designed to allow a cam roller, rotatably connected to the B mold component, to rest therein when mold components A and B are joined.
5. A molding mechanism which will, first, simultaneously form, from injected thermoplastic material, an actuator-overcap for a pressurized container and a spray nozzle insert intended and configured to fit within a fluid discharge outlet in the actuator-overcap, and, second, reposition and then insert the spray nozzle insert into the fluid discharge outlet, the molding mechanism being characterized by having:

an A mold component having formed therein an actuator-overcap forming cavity, and access means to allow injected thermoplastic material to reach that cavity,

a B mold component having protruding therefrom an actuator-overcap forming core, the core having formed therein a spray nozzle insert forming cavity, and, moveably connected to the B mold component, means for repositioning and inserting the spray nozzle insert within the fluid discharge outlet of the actuator-overcap,

the A and B mold components, when fitted together, being configured to form the actuator-overcap within the gap between the actuator-overcap forming core and the actuator-

overcap forming cavity and to form the spray nozzle insert between the spray nozzle forming cavity, and an insert engaging pin moveably attached to the means for repositioning and inserting the spray nozzle insert,

- 5       the A and B mold components being designed to be separated after the forming of the actuator-overcap and the nozzle insert, during which separation the means for repositioning the spray nozzle insert causes the spray nozzle insert to be pulled from its position within the  
10      actuator-overcap forming cavity, repositioned to a location adjacent the fluid outlet of the actuator-overcap, and then inserted into the fluid outlet, and

moveably located within the B component, means for stripping the formed actuator-overcap from the mold after  
15      separation of the A and B mold components and insertion of the formed spray nozzle insert.

6.      A molding mechanism according to Claim 5 wherein the means for repositioning and inserting the spray nozzle insert is made up of, moveably connected to the B mold  
20      component, an independently moveable riser plate on which is mounted a slide and, located upon the slide, an insert engaging pin,

the slide, riser plate, and insert engaging pin, all attached to the B mold component, being designed to  
25      operatively engage the A mold component so that, when the A and B mold components are fitted together and thermoplastic material injected into the gap in the mold cavity formed by this fit (thus forming the actuator-overcap and the spray nozzle insert), the insert engaging pin fits  
30      into the insert forming cavity within the actuator-overcap forming core within the B mold component and forms an attachment to the spray nozzle insert, and, as the A and B mold components are separated, the combination of the slide, riser plate, and insert engaging pin moves laterally and  
35      axially away from the actuator-overcap core, thus removing the spray nozzle insert from the insert forming cavity, the riser plate then moving relative to the slide so as to position the spray nozzle insert adjacent to the fluid outlet of the formed actuator-overcap, the insert engaging

- 18 -

pin then moving forward, inserting the spray nozzle insert into the fluid outlet, and then retracting, the formed actuator-overcap with the spray nozzle insert next being stripped off the actuator-overcap core upon the B mold.

- 5 7. A mechanism according to Claim 5 wherein the motion of the riser plate relative to the mold component is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate is controlled by a two-part cam mechanism, which has a straight stationary cam bar portion located on the A mold component designed to interact with a moveable cam located on the B mold component, the motion of the insert engaging pin relative to the slide being independently controlled by pneumatic pressure applied to the insert engaging pin.
- 10 8. A mechanism according to Claim 5 wherein the motion of the riser plate relative to mold component B is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate and of the insert engaging pin relative to the slide are both controlled by hydraulic pressure which activates a single cam mechanism, said cam mechanism is made up of a moving cam bar having formed into one surface thereof an essentially T-shaped channel, and having first and second cam followers located so as to be moveable within the essentially T-shaped channel, the first cam follower being connected to the slide and the second cam follower being connected to the insert engaging pin, the moving cam bar further having, formed into the surface opposite the one containing the essentially T-shaped cam channel, a cam roller pocket designed to allow a cam roller, rotatably connected to the B mold component, to rest therein when mold components A and B are joined.
- 15 9. A molding mechanism according to Claim 7 wherein the actuator-overcap core and cavity are so configured as to form, integrally with the actuator-overcap, an actuator button and a fluid transfer channel, the fluid transfer channel having at one end thereof a fluid inlet opening and at the other end thereof a fluid discharge outlet, the fluid discharge outlet being configured to form, in cooperation with the spray nozzle insert, a swirl chamber for nebulizing
- 20
- 25
- 30
- 35

- 19 -

a fluid released from a pressurized aerosol container by the action of the actuator button upon the valve of the pressurized aerosol container, the swirl chamber being formed by and between one or more channels formed into the 5 inner base surface of the spray nozzle insert and one or more protrusions formed upon the outer surface of the fluid discharge outlet, the spray nozzle insert and the fluid discharge outlet being telescoped together when the spray nozzle insert is inserted into the fluid discharge outlet, 10 thereby forming the swirl chamber.

10. A molding mechanism according to Claim 8 wherein the actuator-overcap core and cavity are so configured as to form, integrally with the actuator-overcap, an actuator button and a fluid transfer channel, the fluid transfer 15 channel having at one end thereof a fluid inlet opening and at the other end thereof a fluid discharge outlet, the fluid discharge outlet being configured to form, in cooperation with the spray nozzle insert, a swirl chamber for nebulizing a fluid released from a pressurized aerosol container by the 20 action of the actuator button upon the valve of the pressurized aerosol container, the swirl chamber being formed by and between one or more channels formed into the inner base surface of the spray nozzle insert and one or more protrusions formed upon the outer surface of the fluid 25 discharge outlet, the spray nozzle insert and the fluid discharge outlet being telescoped together when the spray nozzle insert is inserted into the fluid discharge outlet, thereby forming the swirl chamber.

11. A method of, first, simultaneously forming, in the same 30 mold, two parts intended to be joined, the parts being a first molded part and a second molded part, and second, fitting the first and the second molded parts together while both are within the mold, characterized by the steps of:

    taking a molding mechanism having an A mold component 35 which has formed therein a cavity and access means to allow injected thermoplastic material to reach that cavity, and a B mold component having protruding therefrom a core designed to form both molded parts, the core having formed therein a cavity designed to form the second molded part, and,

- 20 -

detachably connected to the B mold component, means for repositioning and fitting the second molded part into the desired location in the first molded part,

the A and B mold components, when fitted together,  
5 being configured to form the first molded part within the gap existing between the core and the cavity and to form the second molded part between the cavity designed to form the second molded part, and a second molded part-engaging pin, which is moveably attached to the means for repositioning  
10 and inserting the second molded part,

the A and B mold components being designed to be separated after the formation of the first molded part and the second molded part, during which separation the means for repositioning the second molded part causes the second  
15 moving part to be removed from its formation position within the cavity designed to form the second molded part, repositioned to a position adjacent the desired location on the first molded part, and then fitted into that location, and further having, moveably located within the B component,  
20 means for stripping the assembled first and second molded parts from the mold after separation of the A and B mold components and after the insertion of the second molded part,

applying pressure on the B mold component so that the  
25 B mold component is forced against the A mold component, injecting, through the access means in the A mold component, a thermoplastic material into the gap existing between the core designed to form the first molded part and the cavity designed to form the first molded part as well as  
30 into the gap between the cavity designed to form the second molded part and so that the first molded part and second molded part insert are formed therefrom,

applying force on the B mold component so that the B mold component moves away from the A mold component,  
35 causing the second molded part to be, first, removed from its molding position by the second molded part-engaging pin and second, repositioned adjacent the desired location on the first molded part,

- 21 -

applying power to cause the second molded part-engaging pin to move forward relative to the slide within which it is mounted, thus fitting the second molded part into the desired location in the first molded part, and

5 applying power to the means for stripping so that the assembled first and second molded parts are stripped from their position on the core.

12. A method according to Claim 11 wherein the means for repositioning and fitting the second molded part into the  
10 first molded part is made up of, moveably connected to the B mold component, an independently moveable riser plate on which is mounted a slide and, located upon the slide, a second molded part-engaging pin,

the slide, riser plate, and second molded part-engaging pin, which are all attached to the B mold component, all being designed to operatively engage the A mold component so that, when the A and B mold components are fitted together and thermoplastic material injected into the gap in the molding mechanism formed by this fit (thus forming the first  
20 and the second molded parts), the second molded part-engaging pin fits into the cavity designed to form the second molded part within the core designed to form both molded parts within the B mold component and forms an attachment to the second molded part, and, as the A and B  
25 mold components are separated, the combination of the slide, riser plate, and second molded part-engaging pin moves laterally and axially away from the core designed to form both molded parts, thus removing the second molded part from the cavity designed to form the second molded part, the  
30 riser plate then moving relative to the slide so as to position the second molded part adjacent to the desired location on the formed first molded part, the second molded part-engaging pin then moving forward, fitting the second molded part into the desired location in the first molded part, and then retracting, the assembled first and second molded parts then being stripped off the core designed to form both molded parts upon the B mold.

13. A method according to Claim 12 wherein the motion of the riser plate relative to mold component B is controlled

- 22 -

by a diagonal cam pin, and the motions of the slide relative to the riser plate is controlled by a two-part cam mechanism, which has a straight stationary cam bar portion located on the A mold component designed to interact with a  
5 moveable cam portion located on the B mold component, the motion of the second moving part-engaging pin relative to the slide being independently controlled by pneumatic pressure applied to the second moving part-engaging pin.

14. A method according to Claim 12 wherein the motion of  
10 the riser plate relative to mold component B is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate and of the second moving part-engaging pin relative to the slide are both controlled by hydraulic pressure which activates a single cam mechanism, said cam  
15 mechanism being made up of a moving cam bar having formed into one surface thereof an essentially T-shaped channel, and having first and second cam followers located so as to be moveable with the essentially T-shaped channel, the first cam follower being connected to the slide and the second cam  
20 follower being connected to the second molded part-engaging pin, the moving cam bar further having, formed into the surface opposite the one containing the essentially T-shaped cam channel, a cam roller pocket designed to allow a cam roller rotatably connected to the B mold component to rest  
25 therein, when mold components A and B are joined.

15. A method of, first, simultaneously forming, in the same mold, two parts intended to be joined, the parts being an actuator-overcap having a fluid outlet and a spray nozzle insert therefor, and second, assembling those parts while  
30 they are still within the mold, characterized by the steps of:

taking a molding mechanism having an A mold component which has formed therein an actuator-overcap forming cavity, and access means to allow injected thermoplastic material to  
35 reach that cavity, and a B mold component having protruding therefrom an actuator-overcap forming core, the core having formed therein a spray nozzle insert forming cavity, and, detachably connected to the B mold component, means for

- 23 -

- repositioning and inserting the spray nozzle insert within the fluid discharge outlet of the actuator-overcap,  
the A and B mold components, when fitted together,  
being configured to form the actuator-overcap within the gap  
5 between the actuator-overcap forming core and the actuator-  
overcap forming cavity and to form the spray nozzle insert  
between the spray nozzle forming cavity, and a spray nozzle  
engaging pin moveably attached to the means for  
repositioning and inserting the spray nozzle insert,  
10 the A and B mold components being designed to be  
separated after the formation of the actuator-overcap and  
the nozzle insert, during which separation the means for  
repositioning the spray nozzle insert causes the spray  
nozzle insert to be removed from its position within the  
15 actuator-overcap forming cavity, repositioned to a location  
adjacent the fluid outlet of the actuator-overcap, and then  
inserted into the fluid outlet, and  
moveably located within the B component, means for  
stripping the formed actuator-overcap from the mold after  
20 separation of the A and B mold components and insertion of  
the formed spray nozzle insert,  
applying pressure on the B mold component so that the  
B mold component is forced against the A mold component,  
injecting, through the access means in the A mold  
25 component, a thermoplastic material into the actuator-  
overcap forming cavity so that the actuator-overcap and the  
spray nozzle insert are formed therefrom,  
applying force on the B mold component so that the  
B mold component moves away from the A mold component,  
30 causing the spray nozzle insert to be, first, removed from  
its molding position by the insert engaging pin and, second,  
repositioned adjacent the fluid outlet of the actuator-  
overcap,  
applying power to cause the insert engaging pin to move  
35 forward relative to the slide within which it is mounted,  
thus inserting the spray nozzle insert into the fluid outlet  
of the actuator-overcap, and  
applying power to the means for stripping so that the  
assembled actuator-overcap with its spray nozzle insert is

stripped from its position on the actuator-overcap forming core.

16. A method according to Claim 11 wherein the means for repositioning and inserting the spray nozzle insert is made up of, detachably connected to the B mold component, an independently moveable riser plate on which is mounted a slide and, located upon the slide, an insert engaging pin, the slide, riser plate, and insert engaging pin, which are all attached to the B mold component, all being designed to operatively engage the A mold component so that, when the A and B mold components are fitted together and thermoplastic material injected into the gap in the molding mechanism formed by this fit, thus forming the actuator-overcap and the spray nozzle insert, the insert engaging pin fits into the insert forming cavity within the actuator-overcap forming core of the A mold component and forms an attachment to the spray nozzle insert, and, as the A and B mold components are separated, the combination of the slide, riser plate, and insert engaging pin moves laterally and axially away from the actuator-overcap core, thus removing the spray nozzle insert from the insert forming cavity, the riser plate then moving relative to the slide so as to position the spray nozzle insert adjacent to the fluid outlet of the formed actuator-overcap, the spray nozzle engaging pin then moving forward, inserting the spray nozzle insert into the fluid outlet, and then retracting, the formed actuator-overcap with the spray nozzle insert then being stripped off the actuator-overcap core on the B mold.
17. A method according to Claim 16 wherein the motion of the riser plate relative to mold component B is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate is controlled by a two-part cam mechanism, which has a straight stationary cam bar portion located on the A mold component designed to interact with a moveable cam portion located on the B mold component, the motion of the insert engaging pin relative to the slide being independently controlled by pneumatic pressure applied to the insert engaging pin.

- 25 -

18. A method according to Claim 16 wherein the motion of the riser plate relative to mold component B is controlled by a diagonal cam pin, and the motions of the slide relative to the riser plate and of the insert engaging pin relative 5 to the slide are both controlled by hydraulic pressure which activates a single cam mechanism, said cam mechanism being made up of a moving cam bar having formed into one surface thereof an essentially T-shaped channel, and having first and second cam followers located so as to be moveable with 10 the essentially T-shaped channel, the first cam follower being connected to the slide and the second cam follower being connected to the insert engaging pin, the moving cam bar further having, formed into the surface opposite the one containing the essentially T-shaped cam channel, a cam 15 roller pocket designed to allow a cam roller rotatably connected to the B mold component to rest therein, when mold components A and B are joined.
19. A method according to Claim 17 wherein the actuator-overcap core and cavity are so configured as to form, 20 integrally with the actuator-overcap, an actuator button and a fluid transfer channel, the fluid transfer channel having at one end thereof a fluid inlet opening and at the other end thereof a fluid discharge outlet, the fluid discharge outlet being configured to form, in cooperation with the 25 spray nozzle insert, a swirl chamber for nebulizing a pressurized fluid released from a pressurized aerosol container by the action of the actuator button upon the valve of the pressurized aerosol container, the swirl chamber being formed by and between one or more channels 30 formed into the inner base surface of the spray nozzle insert and one or more protrusions formed upon the outer surface of the fluid discharge outlet, the spray nozzle insert and the fluid discharge outlet being telescoped together when the spray nozzle insert is inserted into the 35 fluid discharge outlet forming the swirl chamber.
20. A method according to Claim 18 wherein the actuator-overcap core and cavity are so configured as to form, integrally with the actuator-overcap, an actuator button and a fluid transfer channel, the fluid transfer channel having

- 26 -

- at one end thereof a fluid inlet opening and at the other end thereof the fluid discharge outlet, the fluid discharge outlet being configured to, in cooperation with the spray nozzle insert further having a swirl chamber for nebulizing
- 5 a pressurized fluid released from a pressurized aerosol container by the action of the actuator button upon the valve of the pressurized aerosol container, the swirl chamber being formed by and between one or more channels formed into the inner base surface of the spray nozzle
- 10 insert and one or more protrusions formed upon the outer surface of the fluid discharge outlet, the spray nozzle insert and the fluid discharge outlet being telescoped together when the spray nozzle insert is inserted into the fluid discharge outlet forming the swirl chamber.

15

1 / 15

FIG. I

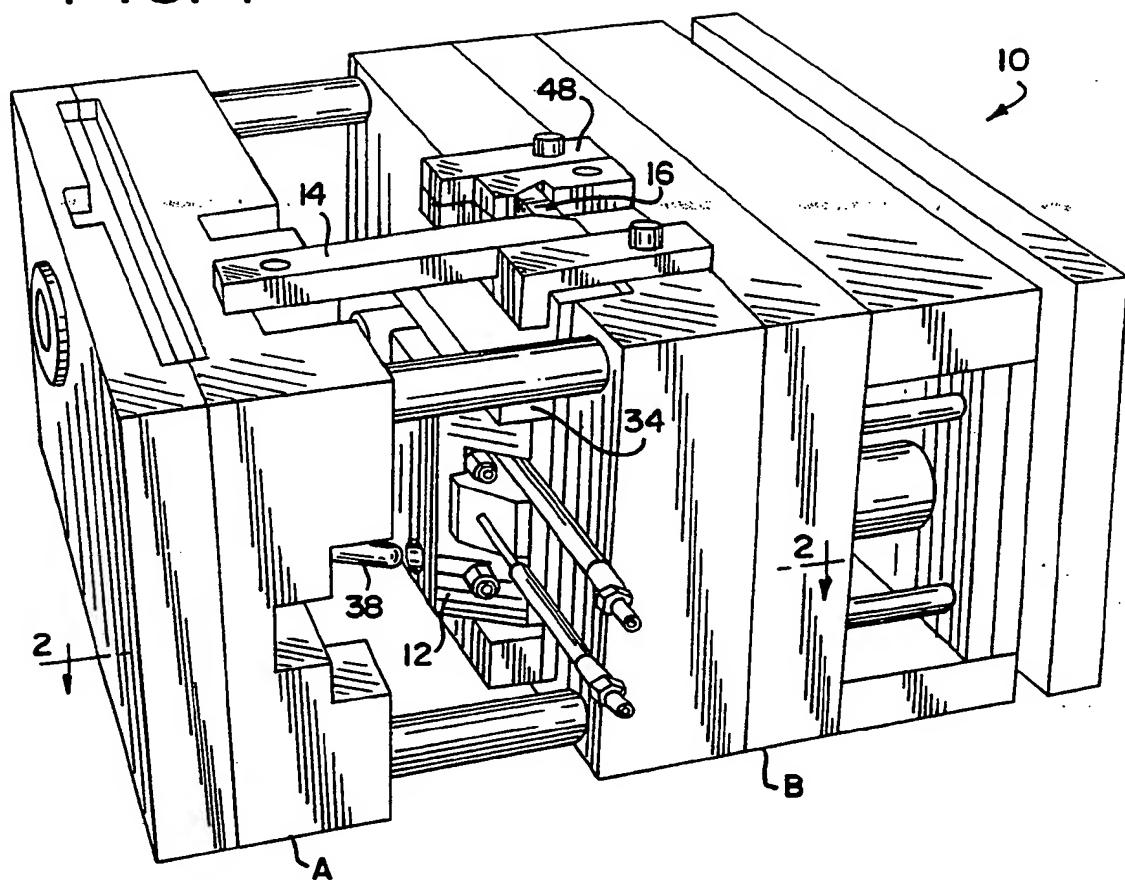
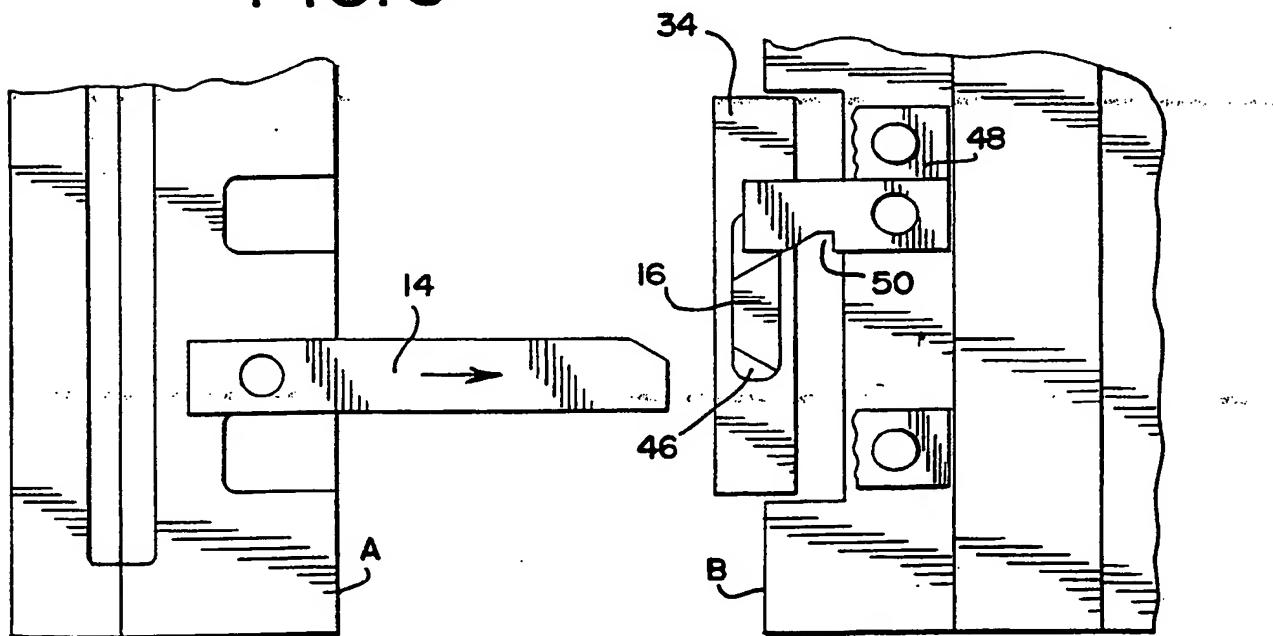


FIG. 9



2 / 15

FIG. 2

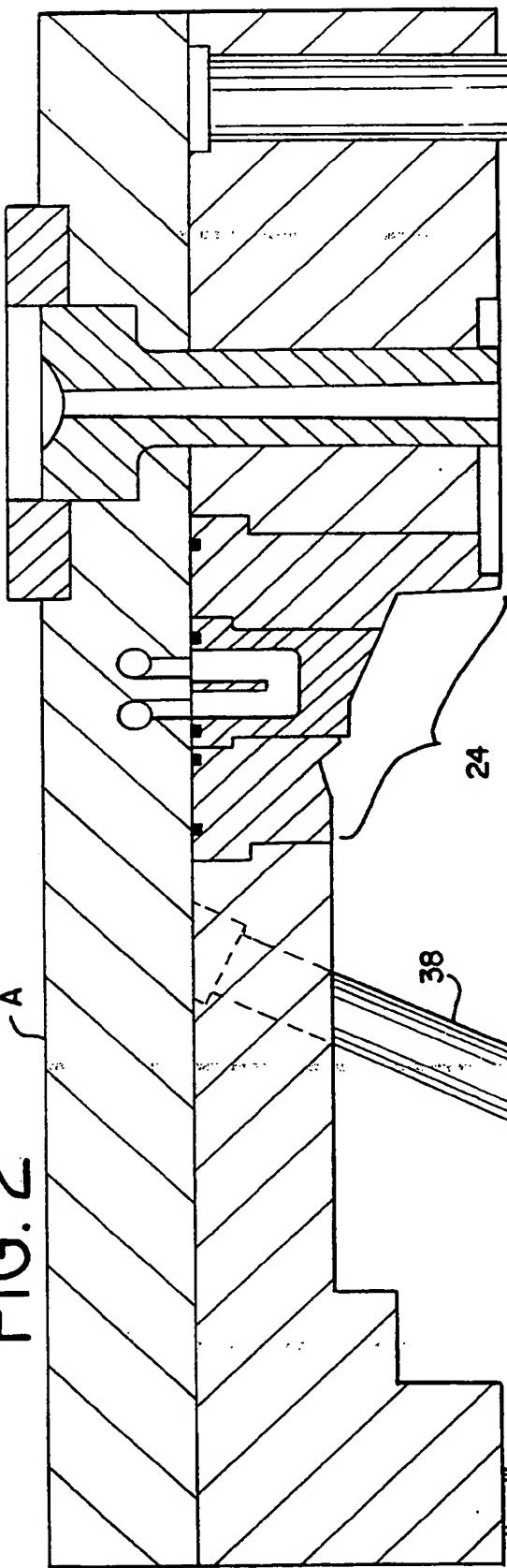
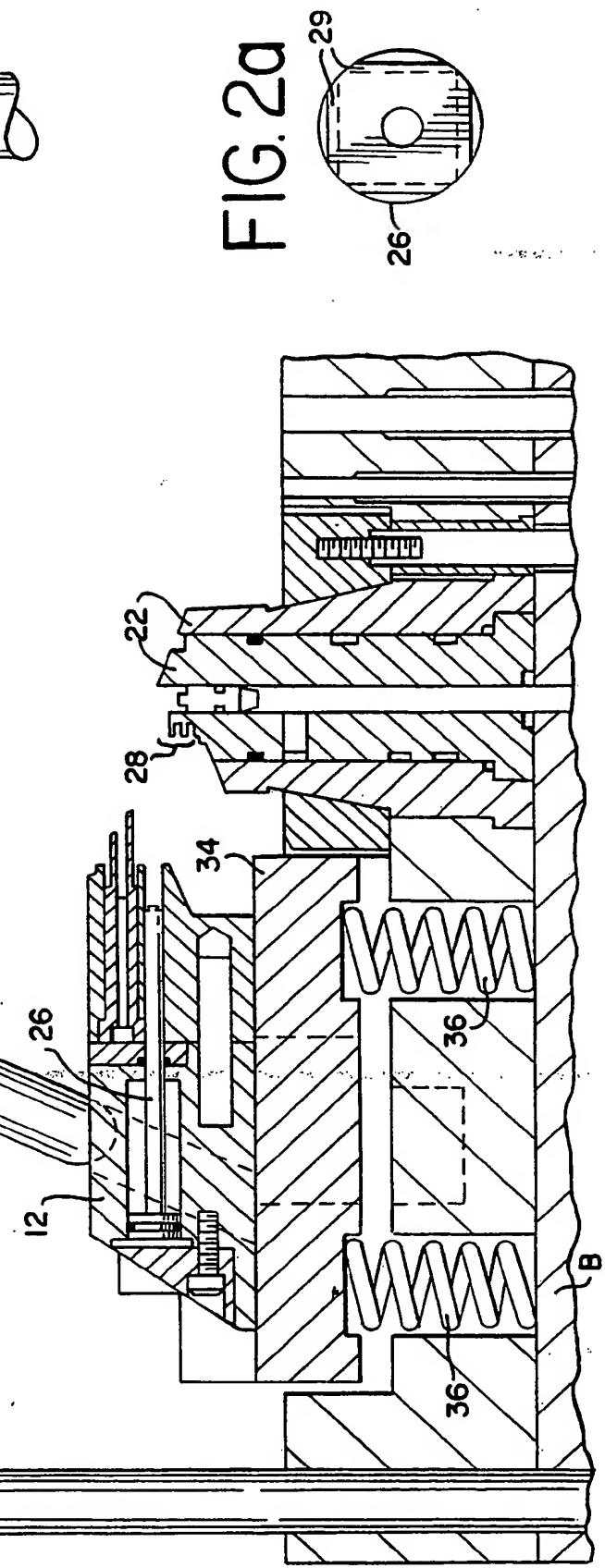
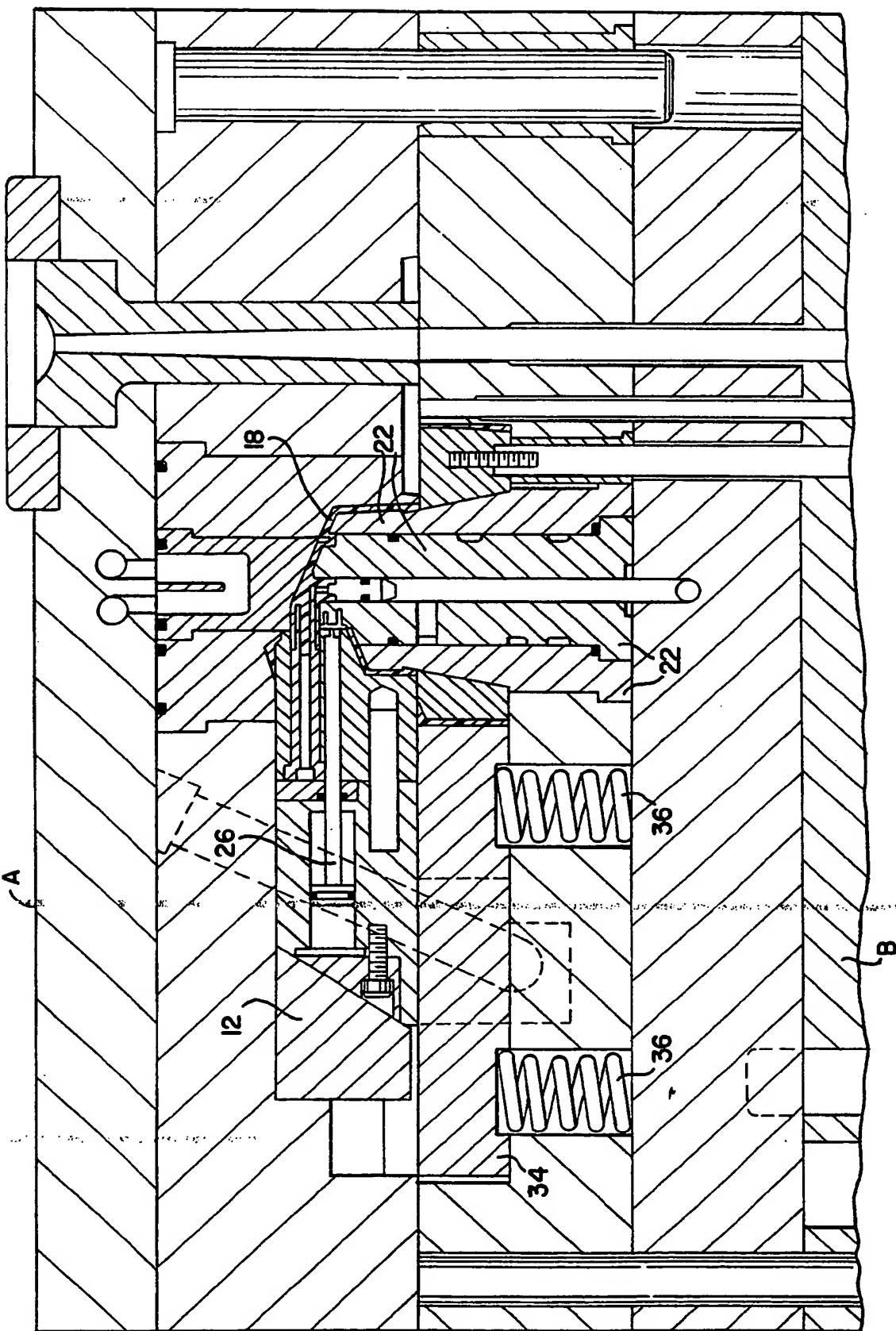


FIG. 2a



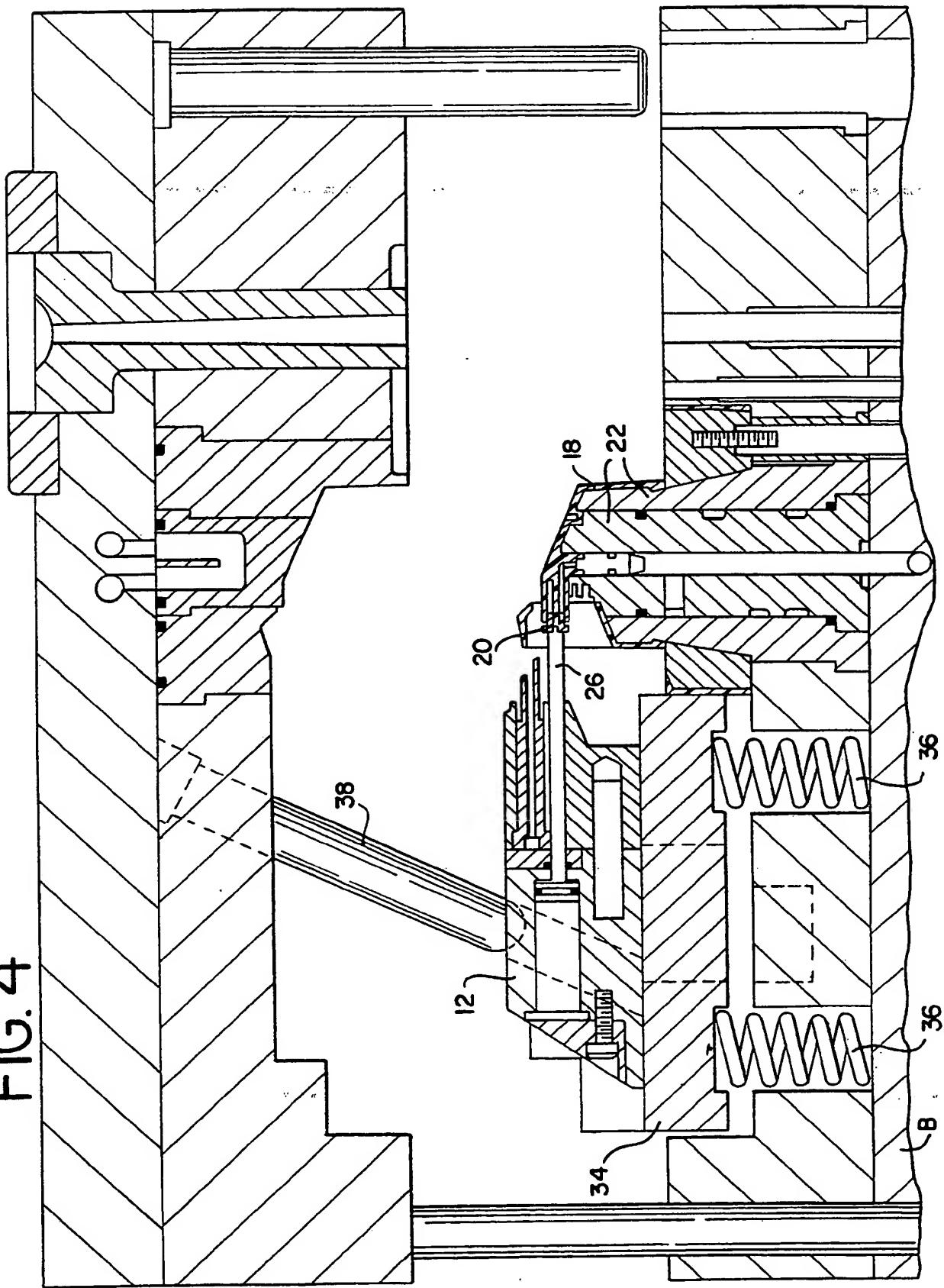
3 / 15

FIG. 3



4 / 15

FIG. 4



5 / 15

FIG.5

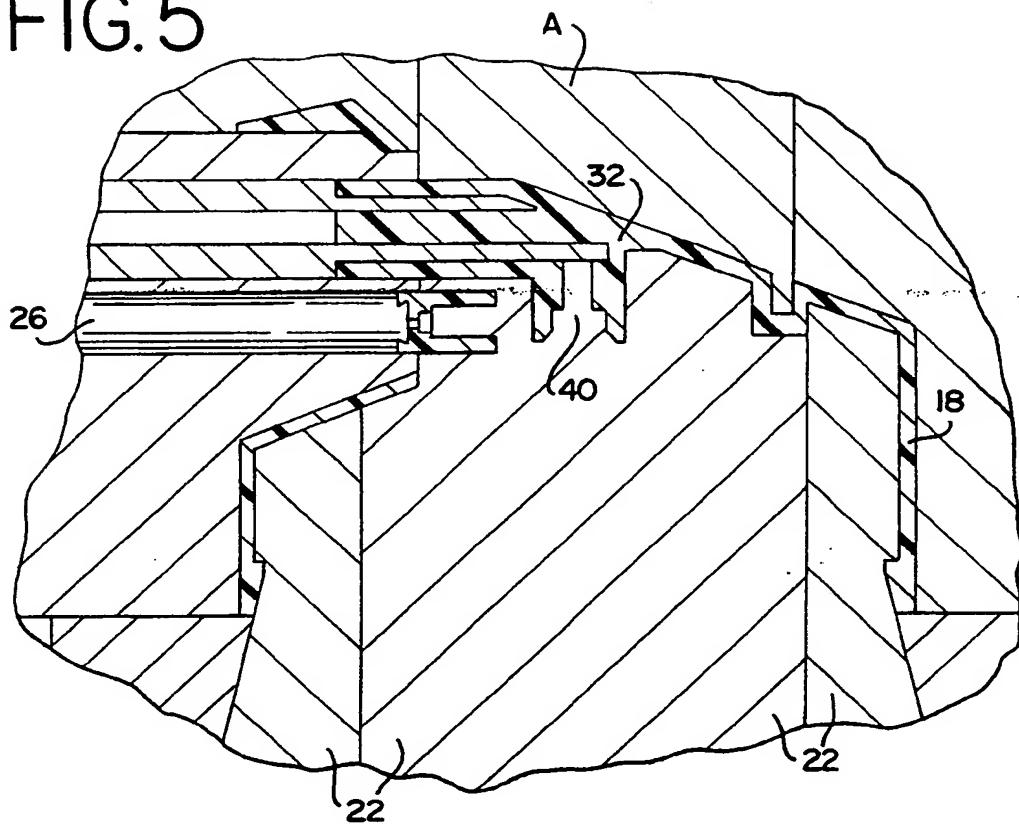
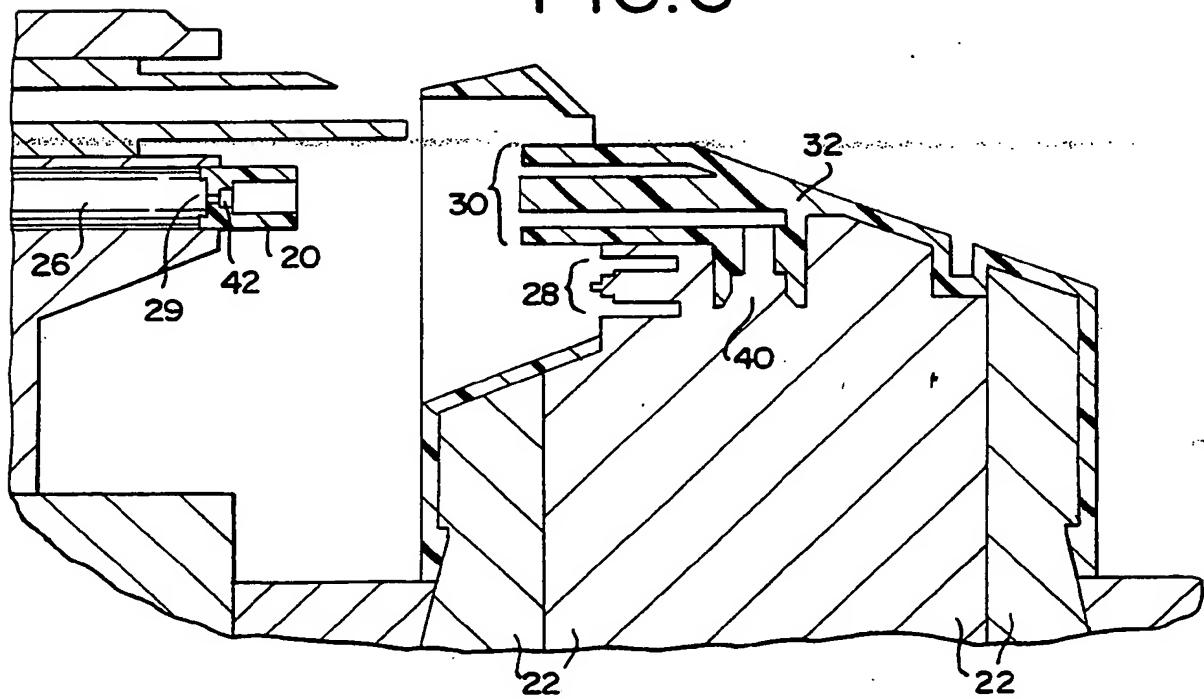


FIG.6



6 / 15

FIG. 7

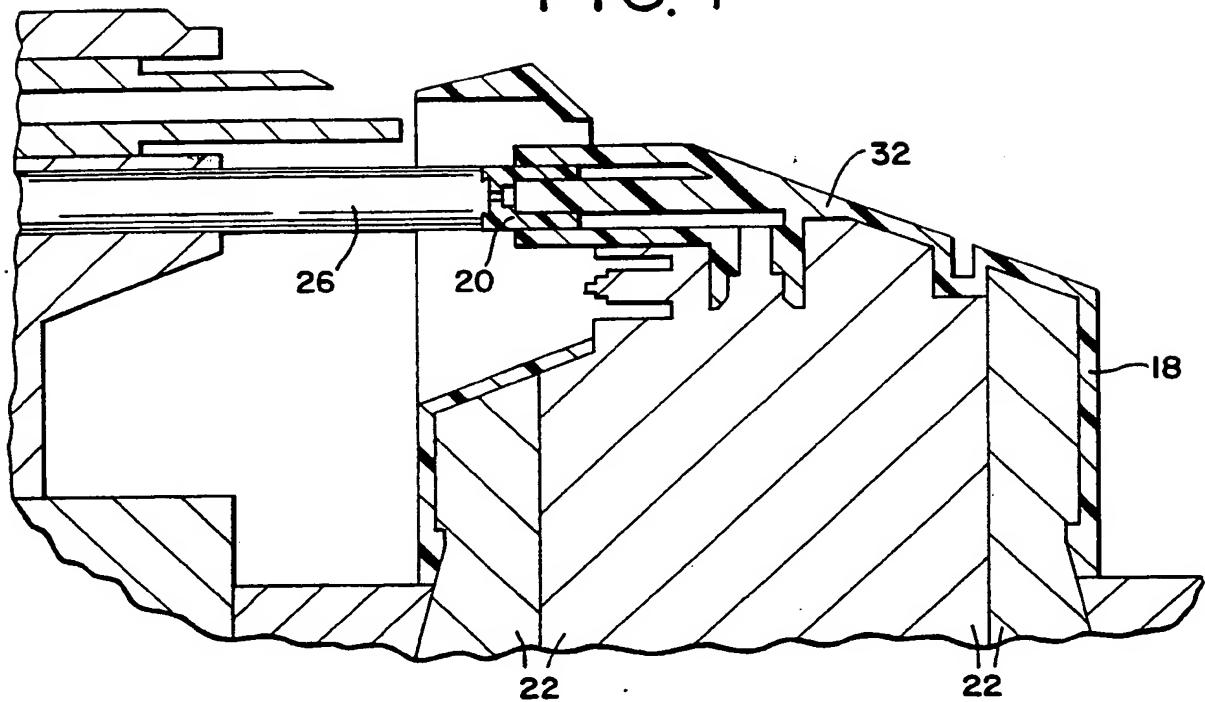
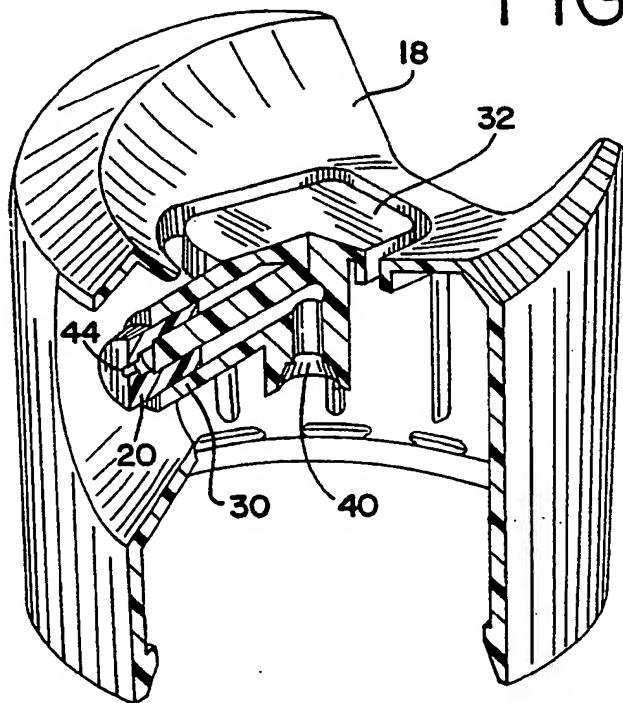


FIG. 8



7 / 15

FIG. 10

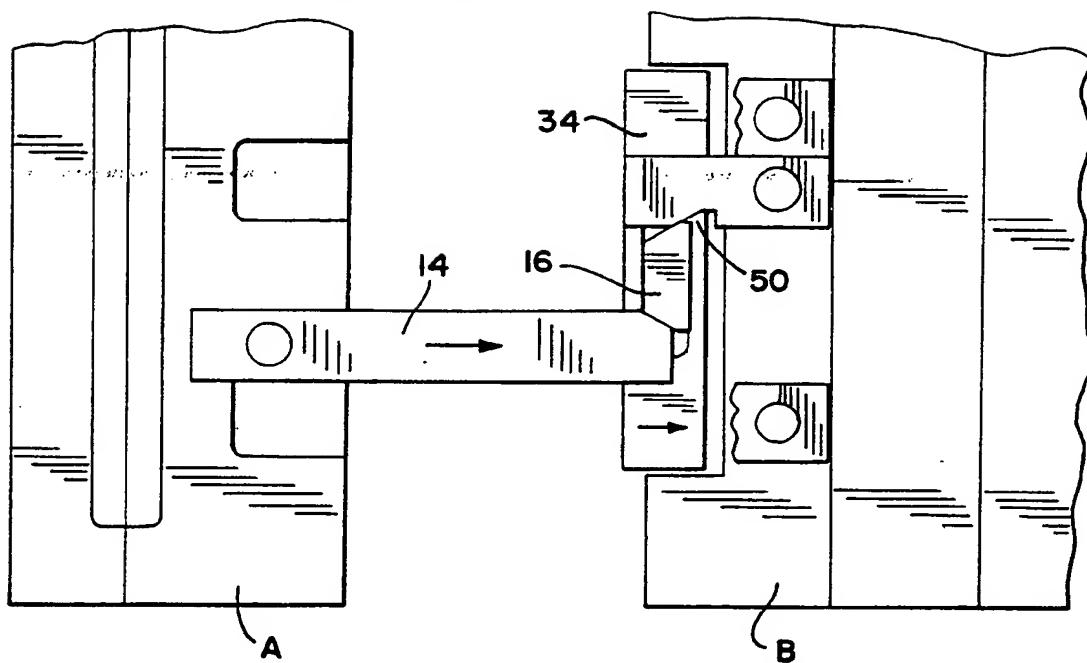
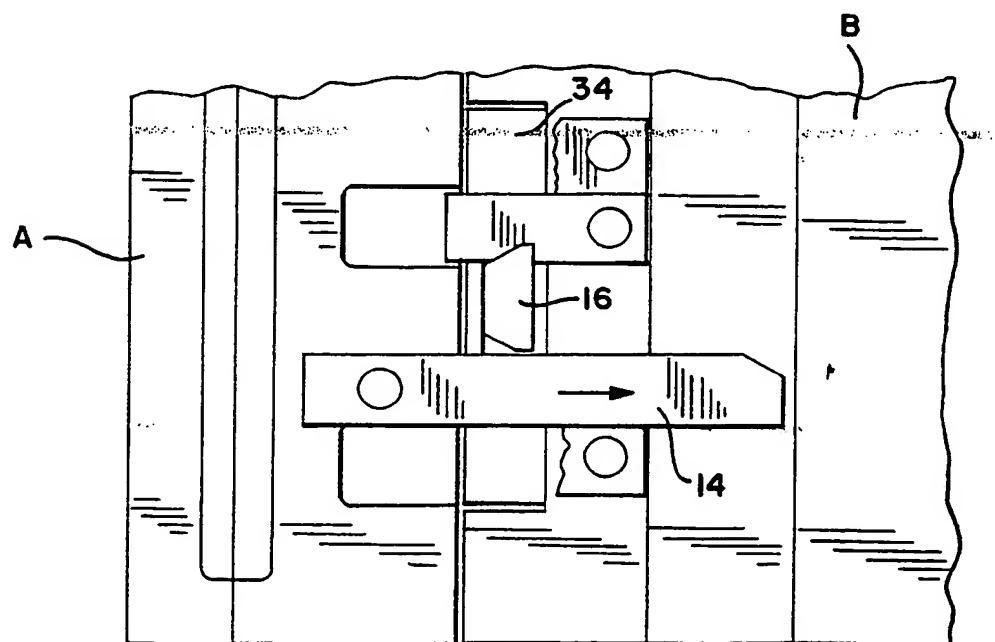


FIG. II



8 / 15

FIG. 12

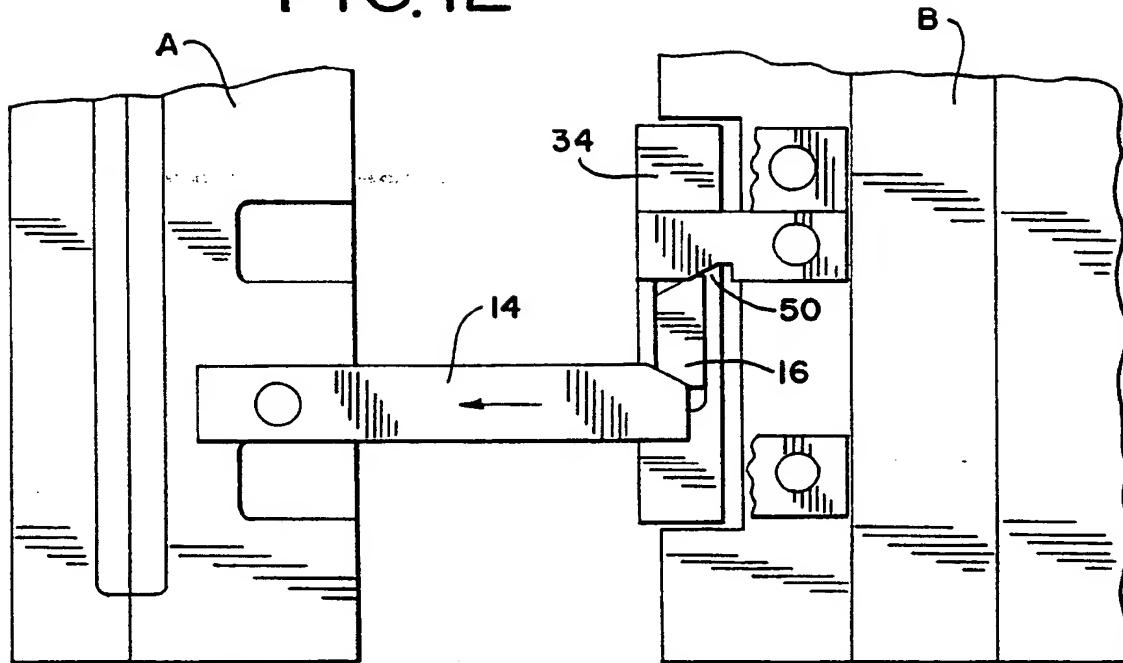
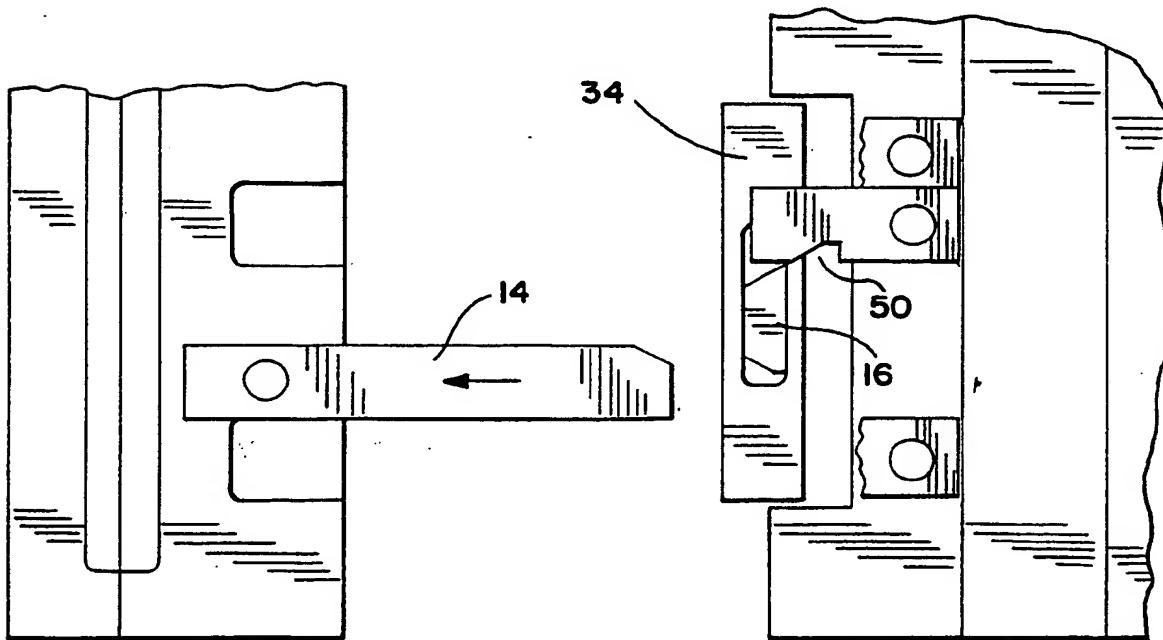
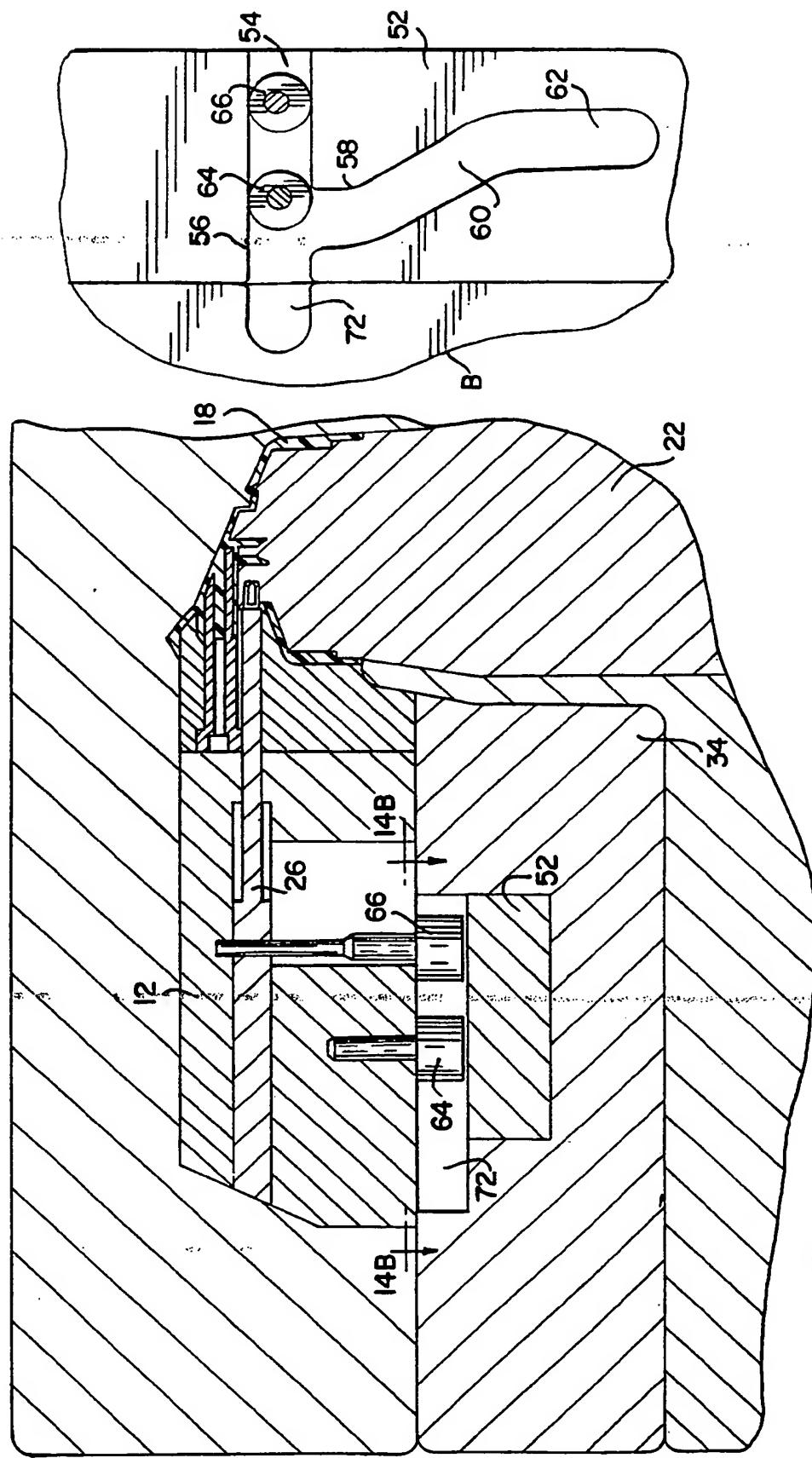


FIG. 13



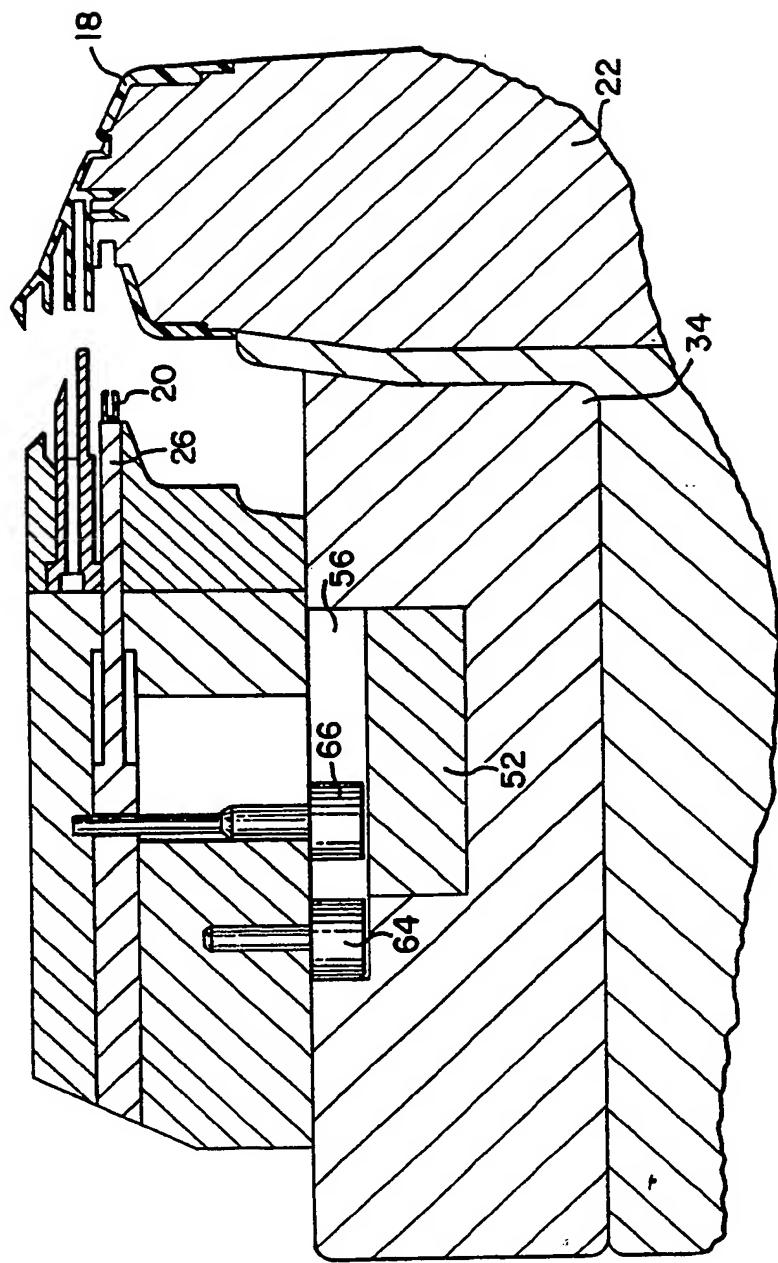
9 / 15

FIG. 14A  
FIG. 14B



10 / 15

FIG. 15A



11 / 15

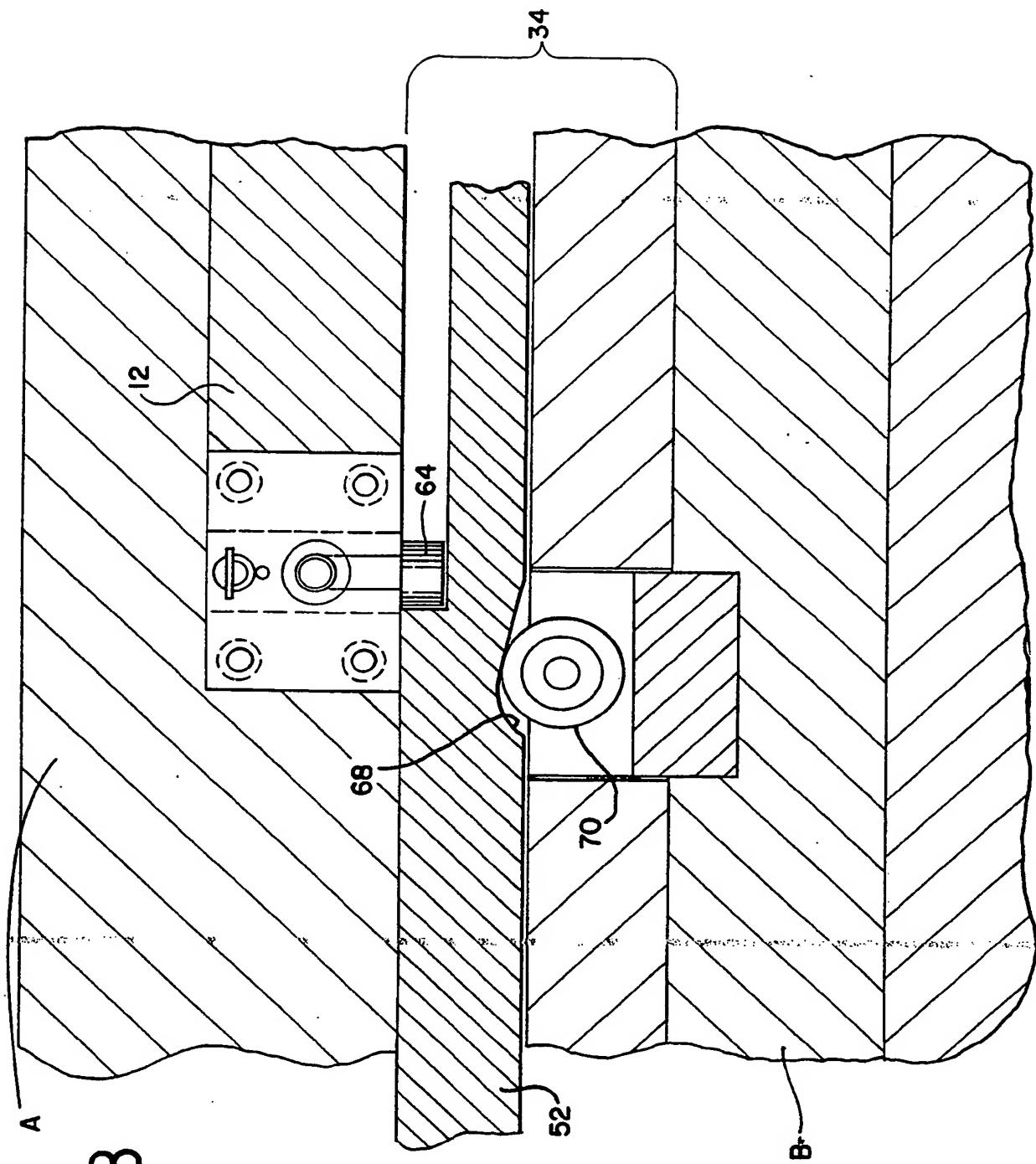
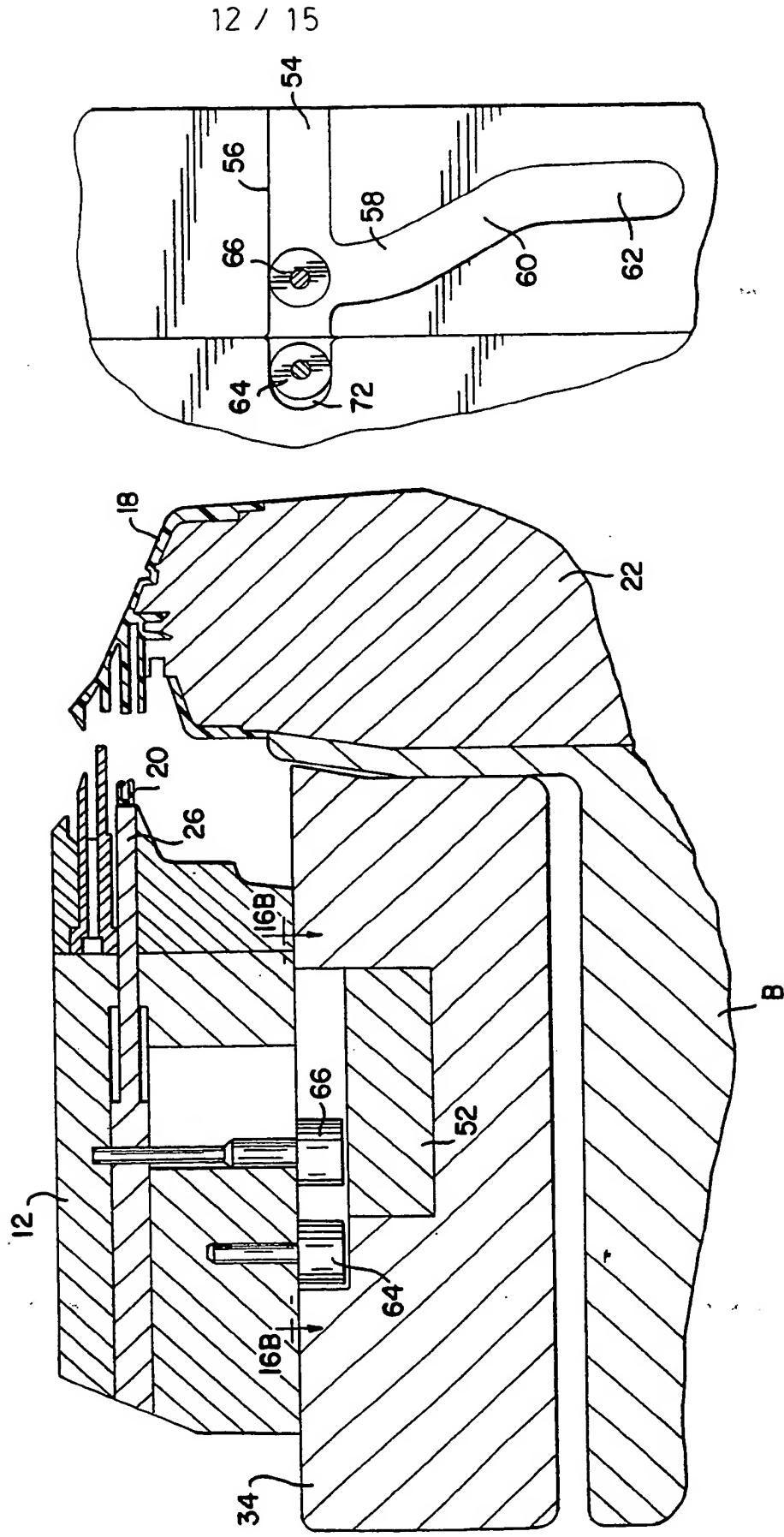


FIG. 15B

FIG. 16A  
FIG. 16B

13 / 15

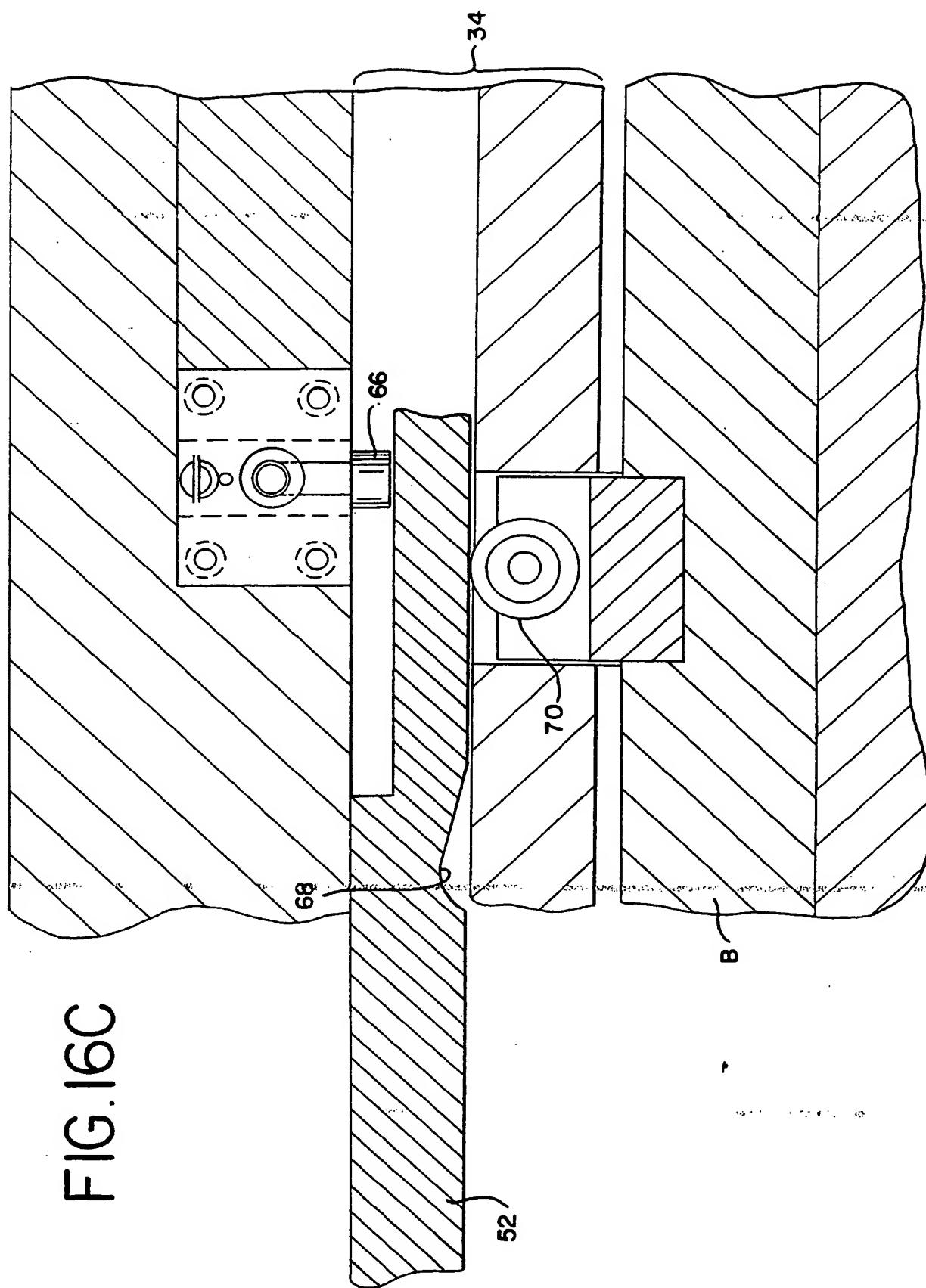


FIG. 16C

FIG. 17A  
FIG. 17B

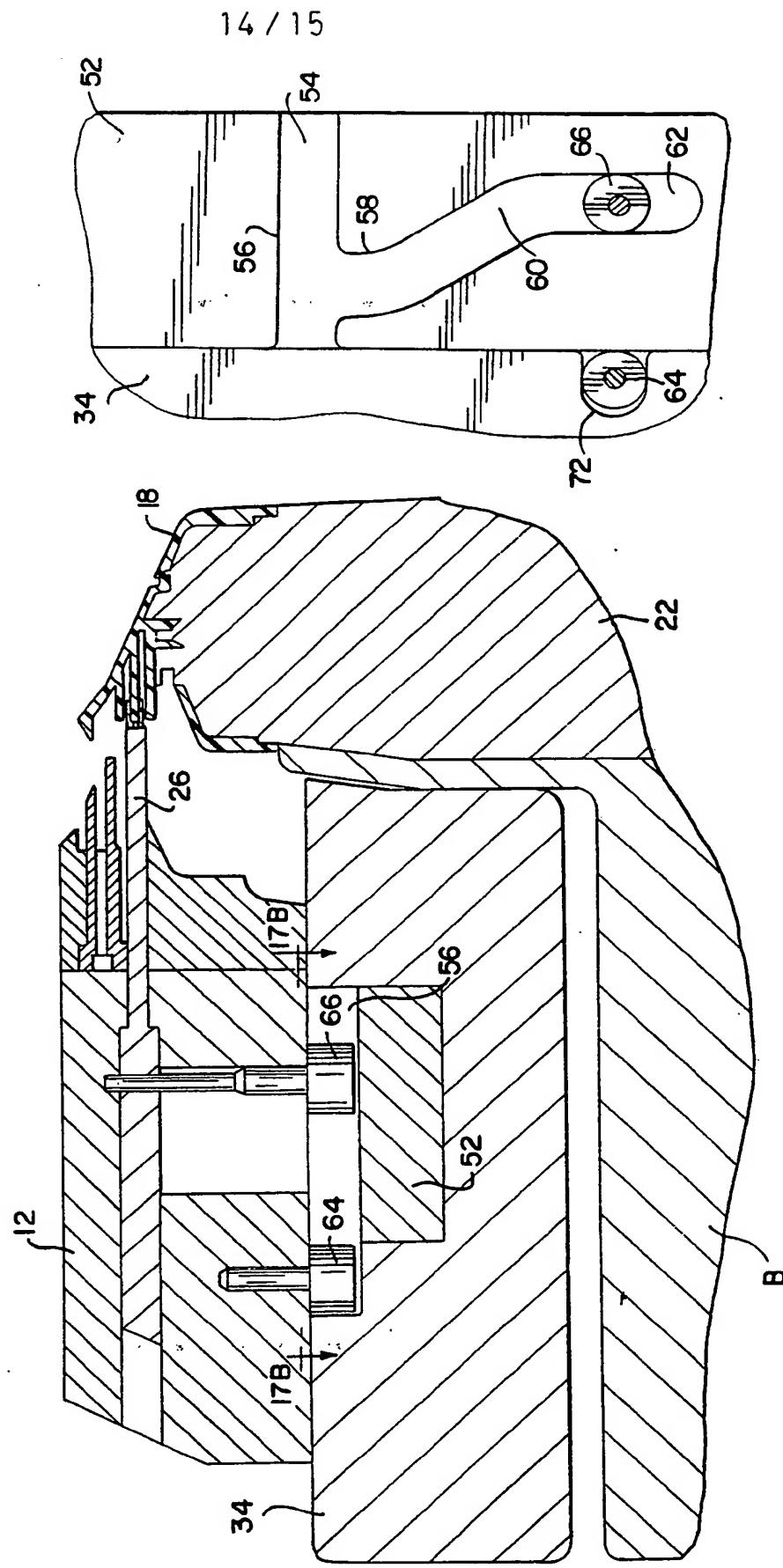


FIG. 18A

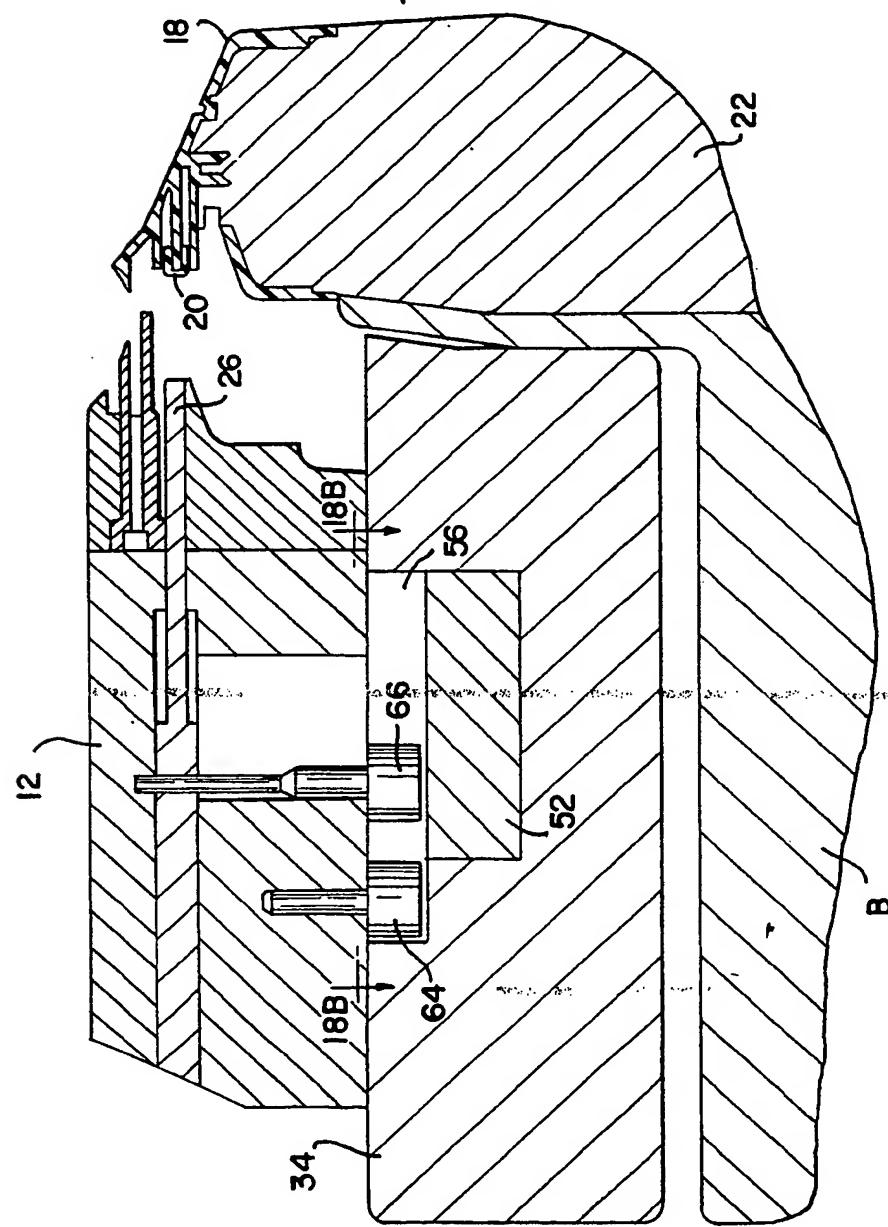
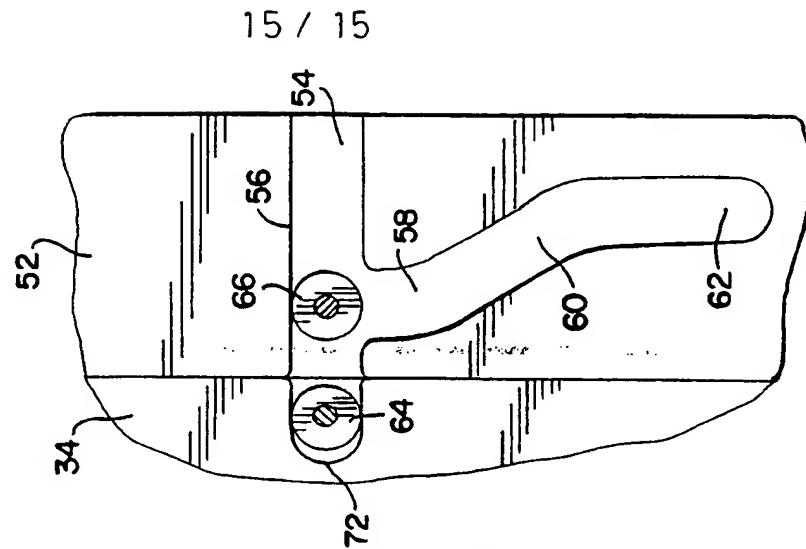


FIG. 18B



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US92/11036

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :B29C 45/00,45/03

US CL :264/238,297.2,297.8,328.8; 425/556,588

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. :

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3,013,308 (AROMOUR) 19 December 1961, See entire document.	1-20
A	US, A, 3,064,310 (COOPRIDER) 20 November 1962.	
A	US, A, 3,657,407 (GRONEMEYER ET AL.) 18 April 1972.	
Y	US, A, 4,340,352 (HAYBERG) 20 July 1982, See column 2, lines 29-53.	2-4,6-10, 12-14,16- 20
A	US, A, 4,351,630 (HAYBERG ET AL.) 28 September 1982.	

 Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means		
*P* document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

08 MARCH 1993

Date of mailing of the international search report

24 MAR 1993

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Facsimile No. NOT APPLICABLE

Authorized officer

M. KAREN AFTERGUT

Telephone No. (703) 308-3831



REG'D. U.S. PAT. & T. OFF.  
INTERNATIONAL DIVISION  
NGOC-HO

Form PCT/ISA/210 (second sheet)(July 1992)\*

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US92/11036

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,547,332 (DROZD, JR.) 15 October 1985.	
Y	US, A, 4,732,726 (GRANNEN, III) 22 March 1988, See abstract.	2-4,6-10, 12-14,16-
Y	US, A, 4,783,056 (ABRAMS) 08 November 1988, See abstract.	2-4,6-10, 12-14,16-
A	US, A, 4,812,116 (ABRAMS) 14 March 1989.	
Y	US, A, 5,037,597 (McGINLEY) ET AL.) 06 August 1991, See abstract.	2-4,6-10, 12-14,16-
		20

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- BLACK BORDERS**
- IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- FADED TEXT OR DRAWING**
- BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- SKEWED/SLANTED IMAGES**
- COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- GRAY SCALE DOCUMENTS**
- LINES OR MARKS ON ORIGINAL DOCUMENT**
- REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**